Guidelines of Applying User's Unconscious Behavior to Product Innovation

by

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Abstract

In today's rapidly advancing technological era, the speed of product iteration is continuously increasing. In such context, innovation in user experience becomes a crucial aspect of business competition. Designers leverage market feedback and technological advancements to enhance product quality, reduce costs, and shorten development cycles. Product iteration is undeniably key to achieving commercial success. Chapter 1 of this study first describes the current real-world issues. In practice, designers often build on the knowledge of previous products while focusing on commercial objectives during product iterations. This approach has led to the creation of products with overly complex functions and forms, which not only fail to enhance user interaction experience but also increase the user's learning and cognitive burden. Simple, intuitive product interactions that naturally align with users' unconscious behaviors are what users need in a fast-paced daily routine. However, current product design research rarely starts from the user's unconscious behavior to explore product interaction. This study is based on Naoto Fukasawa's *Without Thought Design* theory, aiming to develop a Design Guideline that utilizes users' unconscious behaviors during product use to innovate and improve existing product interaction designs.

This thesis adopts an inductive approach, deriving a theoretical design guideline through a literature review. Chapter 2: The literature review covers the origins and relevant theories of unconscious behavior, including studies of the collective unconscious in psychoanalysis and consciousness in ecological psychology. It also includes the definition, importance, and design process of product interaction design. Additionally, Chapter 2 provides a comprehensive review of the foundational theories of *Without Thought Design*. It attempts to analyze these theories through the lens of semiotics and rhetoric. Moreover, Chapter 2 analyzes three types of *Without*

Thought Design, which apply users' unconscious behavior in product interaction in different ways.

Chapter 3 presents the design guideline, highlighting the four key design processes which cover Project Research, Transcribe and Analyze User's Unconscious Behavior, Apply Design Route, and Design Delivery. It explains how to record and analyze users' unconscious behaviors, determine design routes, and innovate interaction design through these routes, ultimately achieving innovation in user interaction experience.

Chapter 4 applies the theoretical design guideline to a practical design project, using a glue gun pen as an example. It provides a detailed description of the specific product and target user research, collection and analysis of unconscious behaviors, and application of design routes. The practical application of this research is demonstrated through two design concepts.

Chapter 5 summarizes the entire content. Overall, this study aims to bridge the gap between users' unconscious behavior and product design, proposing a design guideline that utilizes users' unconscious behavior for product interaction innovation. This approach not only reduces users' cognitive load but also enhances the user experience.

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Table of Contents

List of Figures and Tables

Chapter 1: Introduction

1.1 Problem Statement

As times have evolved, designers gradually shift their focus toward breaking into markets and advancing technology, which sometimes causes burdens to be added to users during the product iteration process. Meanwhile, a design approach called *Without Thought Design* aims to incorporate users' unconscious behaviors into product design, creating more natural interactions without increasing the user's burden. Through research, designers have found that studying user's unconscious behaviors allows them to better innovate products.

1.1.1 Necessity and Misconceptions of Product Iteration

1.1.1.1 Product Iteration Drives Innovation in User Experience

After a product has been on the market for a while, it often requires redesign and optimization based on market feedback and technological developments (Smith et al., 2012; Wellsandt et al., 2018). This process is also referred to as ‘product iteration’ (Eppinger et al., 1994). The reasons for product iteration are multifaceted; they may be due to the identification of flaws in the existing design during the market promotion process, the need to reduce production costs, the need to meet new user requirements, or the need to respond to changes in market trends (Blonigen et al., 2017; Juniani et al., 2022). Consequently, the new product resulting from iteration is usually an improved version of an existing product, incorporating modifications to the previous design to enhance the user's interaction experience or adding new features to meet new user needs based on the existing product (Wheelwright & Clark, 1992).

During the product iteration process, companies often reuse previous design knowledge to address new design challenges. Some studies have shown that over 75% of product design activities involve this reuse of design knowledge (Iyer et al., 2003; Lou et al., 2003). This not

only reduces the uncertainty of design but also accelerates the speed of product development and improves the quality of the design. Therefore, product iteration has become a key component of product development activities (Osborne, 1993). Through product iteration, companies can not only improve the quality and efficiency of the product design process but also make products more feasible and reliable by improving the design. Furthermore, reusing previous design knowledge can also reduce the cost of product development, save design resources, and shorten the development cycle. Therefore, product iteration is an important strategy for maintaining product competitiveness and keeping the brand vibrant.

1.1.1.2 Cognitive Load on Users Caused by Product Iteration

In the early 20th century, industrial design was criticized by commentators, social activists, and theorists in Europe and the United States as a threat to local cultures, emerging economies, and real social relations, and was cast as an 'accomplice' to unscrupulous commercial attention, corporate power, and Western ethnocentrism (Papanek & Fuller, 1972). In 1979, the International Council of Societies of Industrial Design (ICSID) and the United Nations Industrial Development Organization (UNIDO) led a series of working group discussions and initiatives, hosted the groundbreaking Design for Development conference, and formalized the emergence of a human-centered industrial design paradigm, transforming design from a practice whose aesthetic discourse was largely dominated by industrial rationalism, to one of critical intervention with a social agenda (Clarke, 2016).

Under the human-oriented industrial design paradigm, contemporary product iterations focus not only on the basic functionality and formal elements of products but also on the interaction between humans, products, and their usage environments from the perspectives of ergonomics (Soares, 2012) and user needs (Sanders, 1992). However, in pursuit of economic benefits and to meet increasingly complex market demands (Veryzer & Borja de Mozota, 2005),

some product iteration approaches have gradually fallen into a trap, where their response to the human-oriented industrial design paradigm remains superficial. Designers are eager to give products new ways to interact, but these new ways of interacting might be too complex and burdensome for users (Rosson & Carroll, 2002).

Firstly, product iteration processes often ignore the integration between the user's unconscious behavior and the tool's functionality, which is particularly evident in the real world. Frank (2018) raised concerns about intelligent medical tools, suggesting that while these tools offer physicians a novel human-computer interaction experience and have made significant strides in aiding medical diagnosis and treatment, doctors often instinctively resist adopting new technologies. This kind of product iteration, which is distinct from traditional medical equipment, will face challenges in practical application. It's evident that although the design approach aligns with ergonomic principles to some extent, it unavoidably imposes additional learning burdens on users, thereby negatively impacting the overall interactive experience.

Secondly, although some product iteration processes include conducting relevant user surveys in the early stages, most of them focus on capturing users' lifestyle and behavioral phenomena (Sanders & Stappers, 2008), and pay less attention to the unconscious psychological analysis behind these phenomena. Therefore , designers fail to realize that users' lifestyles and behaviors are also influenced by today's socio-cultural environment that emphasizes sensory stimulation. Therefore, the new product designed by the traditional user-centered design method is prone to fall into the misunderstanding of sensory stimulation. For the user, this sensory stimulation is not necessarily positive, and the sensory stimulation brought by today's design work actually forces the user to consciously focus on the information given by the designer to

the product, which gradually weakens the user's subjective experience. Instead, it increases the cognitive burden when interacting with the product (Paas et al., 2004).

The Wenger Swiss Army Knife model 16999 serves as an example (Figure 1.2). It is the largest Swiss Army Knife in the world, weighing nearly 1 kilogram, and integrates 141 functions into 87 tools. Among these are a nail cleaner, a cigar cutter, a telescopic pointer, a fish scaler, a fiber optic tool holder, a toothpick, and a compass. Designers pushed the envelope in combining multiple tools into a single device, but in doing so, they lost sight of the user (Ishai, 2020).

Figure 1.1 Wenger Swiss army knife model 16999 (Michael, 2023)

In conclusion, designers need to be aware during product iteration that while users expect new interaction experiences with updated versions of products to satisfy their needs for innovation and improvement, they also do not want these changes to bring about an excessive cognitive burden, as this can lead to difficulties in use and frustration (Ulrich & Eppinger, 2016). Therefore, when designing new product features or interfaces, developers should strive to balance innovation and user familiarity, ensuring that the new design not only sparks users'

interest but also does not make them feel lost or confused. This means that when adding new functions or improving existing ones, consideration should be given to users' unconscious behaviors, making new interactions as natural and intuitive as possible.

1.1.2 The Inadequacy of Design Research Focusing User's Unconscious Behavior

Product design research is a process of dynamic development. Faced with the constant changes of design objects, science and technology, and manufacturing technology, design researchers are also constantly improving design methods. In terms of product interaction, in 1977, Gibson developed the concept of Affordance, the possibility that an animal's environment provides for action. According to Gibson's research, interaction based on natural behavior does not require additional pressure from the outside world, and product design based on natural behavior is also an important way to improve product interaction quality experience (Norman, 2004). This concept crystallizes the relationship between designer, user, and product, allowing us to understand more clearly how the interaction between people and the environment occurs. Since then, the concept of interaction has evolved from the traditional human-computer interaction design method, providing a new idea for better fitting user habits and reducing the burden of users in the process of product interaction.

Existing theories of human behavior and cognition have demonstrated the reference value of unconscious behavior in helping designers create innovative design ideas in product interaction design (Jameel Mohamed Kamil, 2015). In his book 'Emotional Design,' Donald Norman categorizes design into three levels: visceral, behavioral, and reflective (Norman, 2007). Among these, the visceral level encompasses the study of unconscious human interactive behaviors. Norman describes the design at the visceral level as being able to please users' sensory experiences, that is, satisfying users' sensory experiences and instinctual behaviors through design. Emotional design is also currently the main approach in design studies to investigate

users' unconscious behaviors. Indeed, the source of unconscious behaviors lies in the visceral level (Kamil & Abidin, 2013). However, Norman's interpretation of the instinctual level primarily includes the direct sensory and psychological needs based on human sensory organs (Hua & Fei, 2009). According to some Psychoanalytic research, this definition and explanation seem to neglect that 'instinctual motivations' are also sources of unconscious behavior (Lapsley & Stey, 2011). These 'instinctual motivations' stem not only from users' senses and psychology but also from the influence of socio-cultural factors (Hartmann, 2020) and the long-term accumulation of personal experiences (Lichtenberg, 2013). Therefore, it is insufficient to study users' unconscious behaviors and their impact on design solely from the perspective of emotional design.

1.1.3 *Without Thought Design* —— A Novel Design Method Driven by the User's Unconscious Behavior

In 1998, Naoto Fukasawa initiated an innovative workshop called 'Without Thought'. This workshop criticized the overemphasis on visual and other sensory stimulations in Japanese product design at the time, and it focused on discovering creativity in people's unconscious behaviors and integrating these concepts into product design. Naoto Fukasawa's *Without Thought Design* emphasizes that design should cater to people's unconscious actions and habits, making products naturally intuitive to use. He believes that good design should seamlessly integrate into everyday life, allowing users to use products correctly without much thought. Fukasawa's design philosophy highlights simplicity, intuitiveness, and human-centricity, as seen in many of his works, such as the CD player for MUJI and the Humidifier for PlusMinusZero, which reflect this design approach.

Figure 1.2 CD player and Humidifier designed by Naoto Fukasawa

Adapted from (Deng & Zhou, 2017), (Naoto Fukasawa Design, 2023)

Without Thought Design considers the potential inner needs of users from the perspective of humanization and conforms to the original psychological feelings and behavioral habits of users (Kelley, 2001). However, *Without Thought Design* has not been widely studied in the world, and has not yet formed a scientific and systematic design methodology. Nevertheless, this novel design method provides a new way for design research to explore how to deeply analyze the root of user unconscious behavior and apply it to product interaction design.

1.2 Need for Study

1.2.1 The practice dimension: facilitates successful new product development (NPD)

It's widely recognized that as competition intensifies and technological innovation becomes increasingly challenging, industrial design has emerged as an effective way to position and

differentiate products (Hayes, 1990; Hetzel, 1993). Moreover, the trend toward more complex products and a growing appreciation for the aesthetics of living have made design a critical component in the new product development (NPD) process, even becoming a factor that can give companies a competitive edge (Conti & Chiarini, 2021). In today's dynamic and competitive market environment, NPD managers and design managers alike need to consider how to best manage design and integrate the various disciplines involved in the NPD process, such as design, marketing, and engineering (Veryzer & Borja de Mozota, 2005). These disciplines have a complex relationship within NPD, interacting with one another to determine a product's success or failure. Marketing and design, in particular, inject the user's perspective throughout the NPD process. However, developing successful products and enhancing user experience requires an interrelational approach that encompasses all key disciplines involved in NPD. Scholars have emphasized the importance of 'user-centered' design as a cross-disciplinary approach (Norman, 2007; Veryzer Jr, 1998). Typically, this interdisciplinary method is described as being driven by the user or 'externally driven' (Cagan & Vogel, 2002). However, modern NPD is often driven by the quest for new technological innovations within R&D labs, with new technologies deemed capable of meeting established user needs. Yet, technology-driven NPD accelerates the product lifecycle, with products becoming outdated before they can be refined or developed further, supplanted by newer offerings (Veryzer & Borja de Mozota, 2005). Rapid product updates can prevent a deep consideration of real user feedback, potentially trapping NPD in a vicious cycle.

Hence, a tension still exists between technology-driven and user-driven approaches. The prevalence of technology-driven patterns in NPD is a current trend . Thus, the key to fruitful NPD lies in reaching a balance between technology-driven and user-driven patterns and

maintaining sensitivity to user-centered design considerations in the context of rapid technological innovation and the increasing diversity/complexity of product functions. Utilizing users' unconscious behaviors for product design innovation is an effective strategy for balancing technology-driven and user-driven approaches in NPD. On one hand, unconscious behaviors of users reflect their real usage habits. Designers can create products that align more closely with users' natural habits, thereby enhancing the user experience. On the other hand, some unconscious behaviors of users may reveal new opportunities for design and innovation, prompting technical innovation in products.

1.2.2 The Theoretical Dimension: incorporate users' unconscious behavior into design methodology

With increasing product complexity, product designers are being asked to push their limits and create products that offer greater aesthetic value, functionality, and market competitiveness (Chattaraman et al., 2016). To achieve this vision, the focus of product design has evolved from merely concentrating on the physical design to embracing design thinking and methodologies. Product designers have also begun to delve into the essence of human behavior, paying particular attention to the distinctive, deliberate actions of specific groups such as the elderly, people with disabilities, and children. These groups have consistently been a focal point in the study of product design methodologies (Peirce, 1992; Saptari et al., 2013; Soares, 2012). In contrast, users' unconscious behaviors are often difficult to identify and have thus not been widely discussed by scholars.

However, unconscious behavior holds potential value for successful product design. Designers can capture users' implicit needs through their unconscious actions. Hua and Fei (2009) emphasize that the reason implicit needs are hard to discover is because they can only be fulfilled and balanced by the individuals themselves. For example, the act of someone shaking a

wet umbrella upon returning home to remove water illustrates an implicit need 'not to bring water inside'. This need is conveyed through the unconscious action of shaking the umbrella. Unconscious actions are often completed in an instant, and without a specific design mindset and methodology to offer a new perspective, these actions are usually not easily detected by designers. Therefore, there is a need to develop a design methodology that applies the unconscious behavior of users to product design.

1.2.3 The Social Dimension: the humanity of product interaction design driven by users' unconscious behavior

Nowadays, there is a gradual improvement in people's quality of life and consumption. To maximize benefits and value, modern products in the market are increasingly prioritizing the enhancement of design experiences. This focus on design, however, can sometimes result in product semantics that are not easily comprehensible to users. Consequently, the intentional creativity of these designers, originally intended to align with user needs, can drop into a meaningless form of 'self-expression.'

In essence, designers frequently imprint their personal design perspectives onto products during the creative process, placing a certain burden on the end-users. Within this market landscape, the incorporation of users' unconscious behavior emerges as a reflection of compassionate attention to fulfill societal requirements. An exceptional product harmonizes both its aesthetic form and practical function. Another balance that designers must strike while developing such products is that between the user's objective requirements and the designer's creative ideas. In doing so, humanity can coexist with the designer's creation.

1.3 Objectives of Study

Using users' unconscious behavior in product interaction design is a new idea to improve the interactive experience brought by products to users. It has the characteristic of typical

'bottom-up' constructivism. The starting point of its design activity is not the product itself, but the four symbolic conventions of biological and socio-cultural attributes between the user and the product: i). Symbolic convention of direct intuitive symbolization; ii). Symbolic conventions symbolized by the collective unconscious; iii). The symbolic conventions of society and culture; iv). Symbol specification for the language of product text (Zhang, 2022). When dealing with these four aspects, designers must conform to the judgment of using the unconscious experience of the group, which is the basic guarantee of the validity of design driven by users' unconscious behaviors and the thinking logic of design activities.

In contrast, the traditional approach of product design is a 'top-down' paradigm. This design paradigm takes product function, appearance and other technical indicators as the starting point (Chambers, 1994), and the consideration of user behavior is also in the verification stage after determining product function and operation, which is often the designer's self-justification in the practice process. Therefore, in the practice of design driven by users' unconscious behaviors, designers will face the challenge of changing the conventional design paradigm. There are fundamental differences between design driven by users' unconscious behaviors and traditional product design methods used by product designers, which will directly lead to differences in the purpose, content, thinking mode and implementation path of the two types of design activities. In view of this, this study hopes to explore a guideline for incorporating users' unconscious behaviors in product interaction design to improve product interaction experience, so as to make it an effective approach that can be implemented by designers. The objective of this study is as follows: Developing a guideline for designers to apply user's unconscious behavior to product interaction design.

1.4 Definition of Terms

Affordance: Gibson introduced the concept of 'Affordance' to denote the use value of environmental objects based on the inherent physical characteristics of creatures (Jenkins, 2008). He used this concept to explain the connection between user behavior and the material characteristics of products. With Norman (1988) bringing it into the design field, 'affordance' has become a means to enhance product visibility and usability.

CMF Design: a discipline in industrial design. Color, material, and finish (often abbreviated as CMF) are three basic elements in product development and are important features for constituting functional and emotional attributes of a product (Becerra, 2016). Additionally, CMF design is frequently used in trend-oriented corporations (Qiu & Su, 2012), and in *Without Thought Design*, CMF design also plays a guiding role in the creation of product texts.

Collective Unconsciousness: a concept introduced by Carl Jung in psychoanalysis, referring to the collective, inherited sociocultural experience of a group (Jung, 1936).

Direct Consciousness: the idea that an individual can directly rely on their biological intelligence and initiative to make a holistic perceptual summary of environmental stimuli, without the need for external intervention (Warren, 2005).

Dual Crossover: a type of *Without Thought Design* mixing 'Objective Sketching' and 'Found Objects', which are two basic types of *Without Thought Design*.

Emotional design: a design methodology proposed by Donald Norman. It revolves around the concept of creating products that evoke emotional memories, thereby fostering positive user experiences (Van Gorp & Adams, 2012).

Found Objects: a type of *Without Thought Design* that emphasizes the establishment of rhetorical relationships between the signs outside the product and the signs of the product itself. It does not involve directly applying a certain shape to a product, but rather involves creating a

design theme based on the association between a product And something that is visualized, whether it be an object, a behavioral phenomenon, or a part of it (Takeshi et al., 2016).

Kansei Engineering: a design methodology that utilizes quantitative research methods (Ishihara et al., 2008) to collect product text and user feedback data, creating a database of corresponding relationships (Nagamachi, 1995). It reprograms product semantics based on user intentions, thereby obtaining positive emotional feedback from users (Schütte, 2005).

Objective Sketching: a type of *Without Thought Design*. The designer uses the signs of the product itself to objectively describe the user's unconscious behavior and psychological state. This description does not include subjective interpretations of the designer.

Perceptual Feature: Features such as color, shape, sound, texture, and taste which are detected by specialized sensory receptors and are processed by distinct neural pathways in the brain. These features are integrated to form a coherent perception of the environment (Goldstein, 1989). The perceptual feature in this paper is based on people's five senses. They can be classified into visual features, auditory features, tactile features, olfactory features, and gustatory features. In this paper, the specific classification of product features is carried out.

Power Hand Tools: mechanized tools that utilize small-power electric motors or electromagnets to drive the working head through a transmission mechanism (Lu & Qin, 2005).

Product A: the target product which designers need to innovate.

Product B: the vehicle B that designers look for when using metonymy. It's in the same category as product A, but it's a different product.

Product feature: A feature in product design refers to any distinctive attribute or aspect of the product, which includes but is not limited to its physical structure, functional capabilities, and user interface components (10303-1, 1994).

Product Interaction Design: the creation of a dialogue between people and products. This dialogue is both physical and emotional, manifesting through form, function, and technology (Kolko, 2010).

Product Semantics: a concept developed by Krippendorff & Butter (1984), which is defined as the study of the symbolic qualities of man-made forms within cognitive and social contexts.

Product Text: design elements related to the product itself(e.g. shape, form, color, texture, function etc).

Semiotics: the systematic study of sign processes and the communication of meaning. In semiotics, a sign is defined as anything that conveys intentional and unintentional meanings or sensations to the interpreter of the sign (Sebeok, 2001).

Subconscious: Sigmund Freud used the term 'subconscious' in 1893 to describe associations and impulses that are not accessible to consciousness. He later abandoned the term in favor of unconscious (Laplanche & Pontalis, 1973).

Syntax: 'Syntax' is a branch of semiotics. It examines the logical structure of the rhetorical relationships between one sign system and another (Krippendorff & Butter, 1984).

Thing B: The thing that designers look for when using metaphors. It does not belong to the same cognitive domain as product A. Thing B is a perceptual feature in this study.

Unconscious: the part of the psyche that is not available to introspection (Westen, 1999). It is foundational to Freudian theory and central to psychoanalysis. This study discusses unconscious from the perspective of psychology, so it does not include the unconscious, such as dream and coma, which are regarded as symptoms.

Universal Rhetoric: a central concept in Charles Sanders Peirce's philosophy. It is viewed as a form of metaphor in a broad sense, which is a fundamental way through which we comprehend the world, helping us understand something by viewing it as something else (Peirce, 1992).

Vehicle and Tenor: A complete metaphor consists of two parts: '*vehicle*' and '*tenor*.' The 'vehicle' represents the familiar, concrete cultural life experiences and concepts, which are our intuitive and rich consciousness of the world. The '*tenor*,' on the other hand, represents the abstract entities that we are attempting to understand, often difficult to describe or comprehend directly (Steen, 1999).

Without Thought Design: a design method about designing from the perspective of digging deep human unconscious behaviors (Takeshi, et al, 2016).

1.5 Assumptions

This study is based on the following assumptions:

- This study assumes that products that need to introduce users' unconscious behaviors are in compliance with ergonomic principles and their basic functions are reasonable.
- This study assumes that utilizing unconscious behaviors in design helps designers to develop innovative concepts that benefit users.
- This study assumes that designers using this method possess basic knowledge in design and have the ability to think independently.

1.6 Scope and Limitation

In this study of developing a design guideline for designers to apply user’s unconscious behavior to product interaction design, there are specific scopes and limitations that will apply:

- The focus of this study is on users' unconscious behaviors, and it has limited consideration of the application of ergonomics in power hand tools.

- Due to ethical constraints, this study does not involve any experimental operations related to anthropometry and only provides relevant verification methods as a reference.

- Because product development cannot be fully validated, and the approach is limited by time constraints. Further research will need to be done in the future.

1.7 Procedure and Methodology

The methodology of this research adopted an inductive theory building through a mixed methods strategy in order to address research objectives (Creswell, 2021). The inductive theory building approach consists of the design guideline based on literature review, and then the design guideline is verified by an example.

Phase One: Reviewing literature related to users' unconscious behavior, product interaction design, and the intersection between these two domains. This stage aims to organize and analyze the source of unconscious behavior, unconscious interaction behaviors in product interaction design, and the *Without Thought Design* which is an existing design theory covering users' unconscious behavior. This will lay the theoretical foundation for the construction of design guidelines in the next stage.

Phase Two: Develop a design guideline based on the research outcomes of previous steps using an inductive approach (see Chapter 3).

Phase Three: Develop a prototype of a glue gun pen as a demonstration of how this guideline works in practice to improve product interaction and validate its standardization and ergonomic nature (see Chapter 4).

1.8 Anticipated Outcomes

The anticipated outcome of this study provides a design guideline for applying user's unconscious behavior to product interaction design. This guideline assists designers in capturing users' unconscious interaction behaviors and applying it to product interaction design in a suitable way. Then in Chapter 4, this guideline will be applied to a practical design project to make evident that the guideline proposed in this study is effective.

Chapter 2: Literature Review

2.1 Source of Unconscious Behavior

2.1.1 Psychoanalytic study of the collective unconsciousness

The concept of the unconscious is foundational to Freudian theory and central to psychoanalysis. Freud believed the unconscious primarily stems from repressed life experiences and forgotten psychological content from childhood, which relate to the accumulation and sedimentation of repressed emotions and instinctual desires (Boag, 2018). However, Carl Jung, a Swiss psychoanalyst contemporary with Freud, disagreed with explaining the unconscious purely in terms of desires. Jung (1936) considered desires to be just one of many basic human needs, with spiritual needs being more significant. Jung did not completely reject Freud's theory of the unconscious, but he refuted Freud's naturalistic stance on the origins of the unconscious and emphasized that the unconscious has an innate spiritual predisposition.

Jung (2014) posited that the unconscious is divided into the personal and the collective, structuring human psyche into three layers from the surface to the depth: the ego formed by consciousness, the emotions of the personal unconscious, and the archetypes of the collective unconscious. His theory suggests that consciousness ensures the unity and integrity of the ego, with the capacity to select and discard. The ego acts as a gatekeeper of consciousness, consciously analyzing consciousness, memories, thoughts, and emotions, and preventing content that does not align with self-identity from entering the conscious level (Eisendrath & Hall, 1991). Both the personal unconscious and the collective unconscious significantly influence self-consciousness, with the former composed of complexes and the latter of archetypes (Williams, 2018). The concept of archetypes in the collective unconscious is one of Jung's contributions to psychology, representing the manifestation of countless unconscious choices in specific complex

situations, serving as a source of psychological structure, a way of accumulating experiences, and a source of perceiving meaning. Archetypes, stemming from inherited memory and existing in the form of psychic templates, construct the entirety of human experience (Jung, 1936). Jung also emphasized that the experiential process of archetypes is meaningless in itself, representing only the possibility of a type of action. When a specific scenario provides the possibility for archetype enactment, the archetypal experience is awakened, exerting a compelling instinctual drive on us. It is worth noting that psychologists and psychiatrists use the term 'unconscious' in traditional practices, where metaphysical and New Age literature often use the term subconscious. The meaning of collective unconsciousness proposed by Jung also includes the meaning of subconsciousness in popular cognition, as it covers long term memory, emotions, and habits. However, there are limitations in using subconsciousness to explain the unconsciousness in the product design. Therefore, collective unconsciousness proposed by Jung will continue to be adopted in this paper to define unconsciousness in users' unconscious behavior.

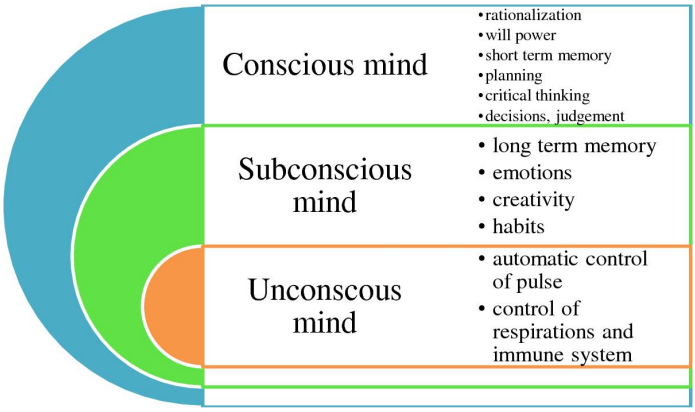


Figure 2.1 Unconscious, subconscious, and conscious mind (Balapala, 2014)

2.1.2 Consciousness Research in Ecopsychology

Firstly, contemporary cognitive psychology subdivides the individual's cognitive process of things into three stages: consciousness, experience, and symbolic perception (Hunt, 1985).

Consciousness itself is further divided into direct consciousness and indirect consciousness by Ecopsychology which is a vital branch of environment psychology (Robbins, 2023; Vicente, 2003). These two modes of consciousness together form the foundation of an individual's life experiences. Symbolic perception, then, is the interpretation of the meaning of these life experiences.

Psychology posits that human psychology and behavior are founded on two primary bases: the biological basis (Neumann, 2010) and the environmental basis (Gifford, 2014). The biological basis is inherent to humans as biological beings, yet it requires the influence of the environment to function. The environment refers to the external world that interacts with the organism; the external world that does not interact with the organism will not constitute an environment (Huang, 2007). Regarding the categorization of 'environment,' there are different standards within psychology: the first divides it into natural and social environments, while the second into physical and psychological environments. However, ecopsychologists, represented by Gibson (1979), argue that categorizing environments based on the artificial and natural world is unclear, as artifacts are made from natural materials. Similarly, dividing them into human and natural environments is also unscientific, as the world made up of material objects and the world constituted by mental products coexist in the same environmental space. Therefore, ecopsychology's categorization of the environment differs from the two aforementioned classifications, basing it on whether the things within the environment require experiential analysis and judgment, dividing it into 'non-experienced environment' and 'experienced environment' (Zhang, 2022). It is worth noting that this categorization in ecopsychology is dynamic, with the criteria for classification changing based on the purpose of observation and the changes in the environment of the observed object (Zhang, 2022). For example, in a crowded

subway, if one is examining the various social psychological interactions between individuals and their fellow passengers, the subway is considered an experienced environment. Conversely, if examining the impact of passengers' physical contact with handrails, seats, and the sway of the moving subway on standing stability, the subway's public facilities are considered a non-experienced environment.

■Direct consciousness:

Gibson's (1966) concept of 'affordance' aids in understanding the meaning of direct consciousness. Within this theoretical framework, humans with intelligent characteristics actively acquire information from their environment. When the environment provides sufficient and complete information, the one-way relationship of information provision to an individual is termed 'affordance.' Through this relationship, an individual can directly rely on their biological intelligence and initiative to make a holistic perceptual summary of environmental stimuli, without the need for external intervention. This process forms a coordinated unity among the environment, body, and brain. Gibson refers to the formation of this type of consciousness as direct consciousness (Warren, 2005). In direct consciousness, the stimulus information obtained from the environment by the user is rich and complete. After being transmitted to the brain, it does not require further analysis, screening, or judgment through the individual's life and cultural experiences to form a complete perceptual summary, and based on the judgment of consciousness, triggers subsequent behavior.

'Direct consciousness' originates from the experimental methods of ecological science, discussing the formation of human consciousness within the environment. This research paradigm intentionally diminishes or even temporarily sets aside the social and cultural attributes of human individuals, considering the consciousness obtained by an individual in the environment as a kind of biological nature (Wiltshire et al., 2015). Direct consciousness depends

on the consciousness formed by the relationship between an individual's biological attributes and the environment. Its capability to extract information stems from the symbiotic relationship humans have with the environment through long evolution and coexistence. Therefore, direct consciousness has biological characteristics and hereditary properties.

■Indirect consciousness:

Direct consciousness indicates that individuals' psychology and behavior have biological functional characteristics, but human individuals exist not only as biological entities; their psychology and behavior are more influenced by the social and cultural environment (Erkan & Arehjan, 2022). Cooper and other scholars (2012) emphasize that psychological research should borrow the scientific methods and means of direct consciousness, but it must be grounded in the social and cultural context, establishing a research system that integrates 'environment-social culture-psychological behavior.'

Bruner (1990) opposes the direct consciousness theory, which treats humans as passive receivers of information. He believes that consciousness is a process in which an individual reconstructs things, combining the information of what they perceive with their existing life experiences to make a hypothesis and identification of the external object. Bruner advocates that human individuals have the ability to actively select and deduce information, forming subjective perceptual hypotheses. He considers consciousness to be an active construction process that filters and evaluates information according to one's experiential world. Furthermore, Bruner adds that the information individuals perceive in the environment, after being analyzed and judged by their existing experiences, will be integrated into their cognitive accumulation, becoming the perceptual mode for hypothesizing and identifying information obtained in the environment next time. This perceptual mode is referred to by psychologists as 'indirect consciousness' (Rock, 1997).

The coexistence of individuals' biological and cultural attributes is the fundamental reason for the coexistence and interweaving of direct and indirect consciousness in the individual perceptual system, with social and cultural life experiences being the main basis and source for the analysis and judgment of indirect consciousness. Unlike the biological characteristics and hereditary attributes of direct intuition, the theme of the formation process of indirect consciousness is the accumulation of individual experiences. Therefore, compared to the individual differences in direct consciousness, the individual differences in indirect consciousness appear more complex (Zhang, 2022).

2.2 Product Interaction Design

2.2.1 The Definition of Product Interaction Design

From a product design perspective, the work of designers is both functional and linguistic. Through visual and semantic language, successful design allows the audience not only to engage in a dialogue with the designer during the experience but also to truly understand the content the designer aims to convey, fostering emotional resonance (Demirbilek & Sener, 2003). The audience must truly recognize the designer's intent and accept the presented culture of language. Eckert and Stacey (2000) argue that product designers do not use language to design; rather, design itself is a language. The linguistic characteristics of form, function, color, and other elements are conveyed through the interaction between the product itself and the user. Interaction designers use both words and forms, constructing compelling arguments and inviting users to share in their thought processes. The work evolves over time and is completed by the presence and synthesis of the audience.

Although humans have been designing interactions for centuries, interaction design has been considered a distinct discipline only for about 20 years (Kolko, 2010). This domain has deep roots across various existing disciplines. However, as times evolve, interaction design often gets

confused with web design, partly because people interact with websites and partly because web development teams find it valuable to work with interaction designers. Interaction design also gets mislabeled by business owners as multimedia or interactive design. The most notable difference between interaction design and interactive design is that interactive design is mostly technology-centered, while interaction design is human-centered (Kolko, 2010). Most interactive designs are constrained to a specific software package and its capabilities, rather than being centered around the constraints of the end user, which is the focus of interaction design.

Interaction Design is complex and encompasses far more than just the creation of websites, multimedia design, or graphical-user interfaces (GUIs). It doesn't always need to focus on advanced technology, though some form of technology usually plays a significant role. Kolko (2010) provides an academically inclined definition of the field: Interaction Design is the creation of a dialogue between people and products, systems, or services. This dialogue is both physical and emotional, manifesting through form, function, and technology. Interaction designers are, in essence, shapers of behavior. For product interaction designers, their endeavor is to understand and shape human behavior, which is the discipline's contribution to the real world: understanding and changing the way people live their lives.

2.2.2 The Significance of Product Interaction Design for Product Innovation

The roots of product design lie in the Industrial Revolution, as technology and manufacturing allowed objects to be created in various ways, quickly and cost-effectively (Morris, 2016). Product design is typically associated with the creation of everyday items such as furniture, appliances, and tools. It has traditionally been considered a profession responsible for the styling and aesthetic appeal of objects. At one point, product designers were often brought in during the final stages of product development to design the appearance of the product. However, in recent years, the field of product design and development has undergone a

significant transformation, with designers realizing that their work involves more than just aesthetics or material selection (LaRoche & Traynor, 2010). They are designing for 'real people' who will use the products they create. This emphasis on people rather than style is reflected in the subfield of human factors engineering and was popularized in the designs of Henry Dreyfuss (Flinchum, 2000). Dreyfuss found himself considering human physical dimensions when striving to create emotional and physical relationships between people and objects. His efforts brought about a significant shift in product design, recognizing several important considerations:

1. People are unique, and have characteristics that may differ from the 'average'
2. Designing for human factors requires different tools and theories than designing for aesthetics.
3. The field of industrial design is larger than form design.

As the field of product design has evolved, so too have the criteria for evaluating product quality. 'Usability' has long been a standard for judging whether a product is practical and has always been part of the assessment of product quality (Bevan, 1995). However, in today's context of intensified market competition and increasing difficulty in achieving technological differentiation, some characteristics beyond 'usability' have become important factors in making the quality of a product stand out and become desirable to people (Veryzer & Borja de Mozota, 2005).

Interaction design draws heavily from the field of psychology in terms of cognition, memory, and consciousness. It also borrows from the fields of art and design, as it involves aesthetics and emotion. Successful interaction design affects users on an emotional and personal level. Product interaction designers must become experts in studying how humans connect with each other and with the world, as well as the constantly changing nature of technology and business. From a

usability perspective, this understanding of behavior is important because technology has exposed people to a vast amount of sensory stimulation (Thackara, 2006), and there can be a significant learning cost and psychological burden when people need to learn to use a new, complex product (Mugge & Dahl, 2013). When interaction design moves beyond being an advocate for simple usability and begins to herald the creation of more poetic design solutions, the quality of the product will transcend 'usable' and reach 'desired by users' (Kolko, 2010).

2.2.3 Design process

Essentially, product innovation is about innovating the interaction between user and products. When designers developing the basic framework of the guideline, they can follow some design processes from product interaction design.

The Double Diamond, created by the UK Design Council, is a fundamental design framework that provides a structured design process. It has four stages: Discover, Define, Develop, and Deliver. In 2019, the Design Council updated the Double Diamond model to a new model called the Innovation Framework (Figure 2.2) to better identify and address design challenges (Council, 2019).

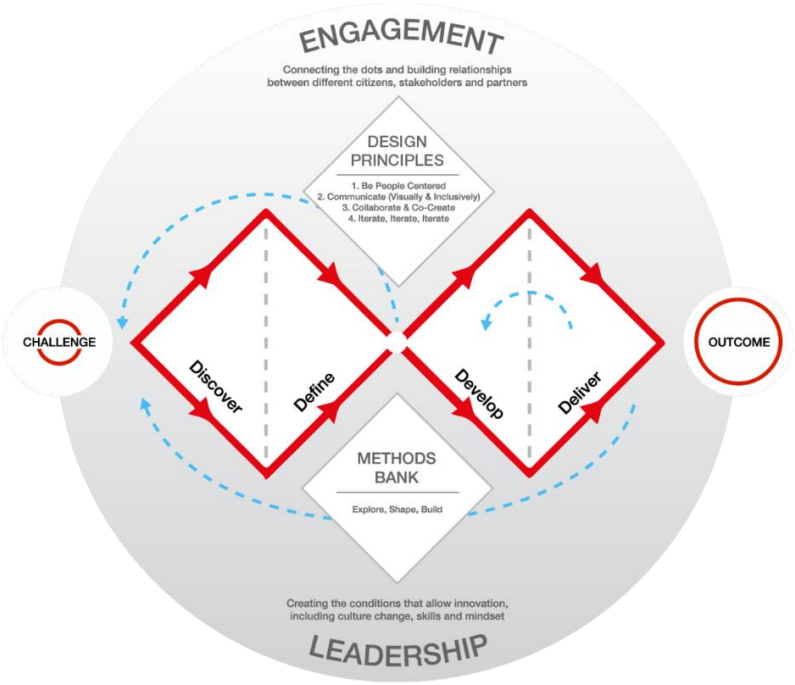


Figure 2.2 Design Council's Framework for Innovation (Council, 2019)

Compared to the Double Diamond, the Design Council's Framework for Innovation is a nonlinear iterative process that focuses on deeper exploration of problems and taking focused action. Additionally, this framework proposes four design principles: (1) Users first; (2) Communicate visually and inclusively; (3) Collaborate and co-create; (4) Incrementally iterate. By using this framework, designers can explore products and users, shape expectations, and build design concepts.

In addition, there is another nonlinear and iterative process proposed by Kumar (2012) in the book *101 Design Methods: A Structured Approach* (Figure 2.3). This innovation design model consists of four quadrants: research, analysis, synthesis, and realization. There are seven distinct modes of activity in design innovation: sense intent, know context, know people, frame insights, explore concepts, frame solutions, and realize offerings.

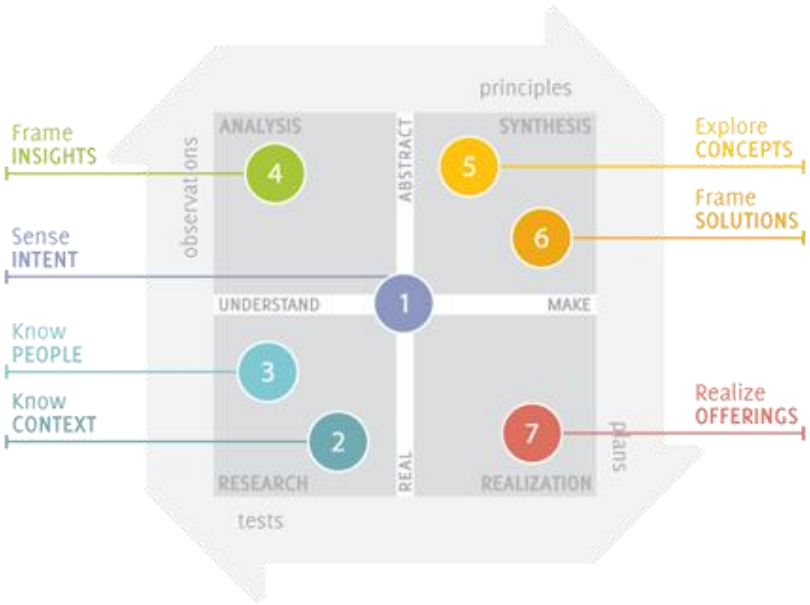


Figure 2.3 Innovation Design Model (Kumar, 2012)

Based on these design processes, there are four steps to innovative user experience and product interaction.

- Conduct deep research about design project and target users.
- Collect information to identify problems.
- Develop design concept and generate solutions.
- Design delivery.

These two models provide designers with four steps to study the interaction between user and product, and to enhance product innovation. A more detailed design process will be developed in Chapter 3.

2.3 Application of Users' Unconscious Behavior in Product Interaction

2.3.1 Types of Users' Unconscious Behavior in Product Interaction

Based on the literature analysis of psychoanalytic studies on the collective unconscious and ecopsychology research on intuition, human unconscious behavior originates from three sources: direct consciousness, indirect consciousness, and the collective unconscious. *Direct*

consciousness arises from an individual's biological intelligence and proactivity in making holistic perceptual summaries of environmental stimuli, without the need for the brain to reprocess the body's instinctual responses. This process forms a coordinated unity between 'environment-body-brain.' Notably, direct consciousness, influenced by an individual's biological attributes, has universality in the human group context. *Indirect consciousness* occurs when the information an individual perceives in the environment is analyzed and judged based on their existing experiences, then integrated into their cognitive accumulation, forming a perceptual mode for hypothesizing and identifying information obtained in the environment next time (Rock, 1997). Compared to the universality of direct consciousness in the human group context, indirect consciousness shows greater variability among individuals due to the intervention of individual experiences. The concept of the *collective unconscious* represents a contribution from psychoanalysis to the study of human unconscious behavior. The collective unconscious refers to a shared, inherited unconscious structure among a group of people, containing common elements of group history and experience, known as archetypes. Unlike indirect consciousness, which is the product of personal experience, the collective unconscious is a shared spiritual heritage of humanity, influencing individuals' unconscious behavior. Mills (2019) argues that the *collective unconscious* is a deeper layer of individual unconsciousness, containing universal signs and images. The relationship among *direct consciousness, indirect consciousness, and the collective unconscious* is illustrated in Figure 2.4.

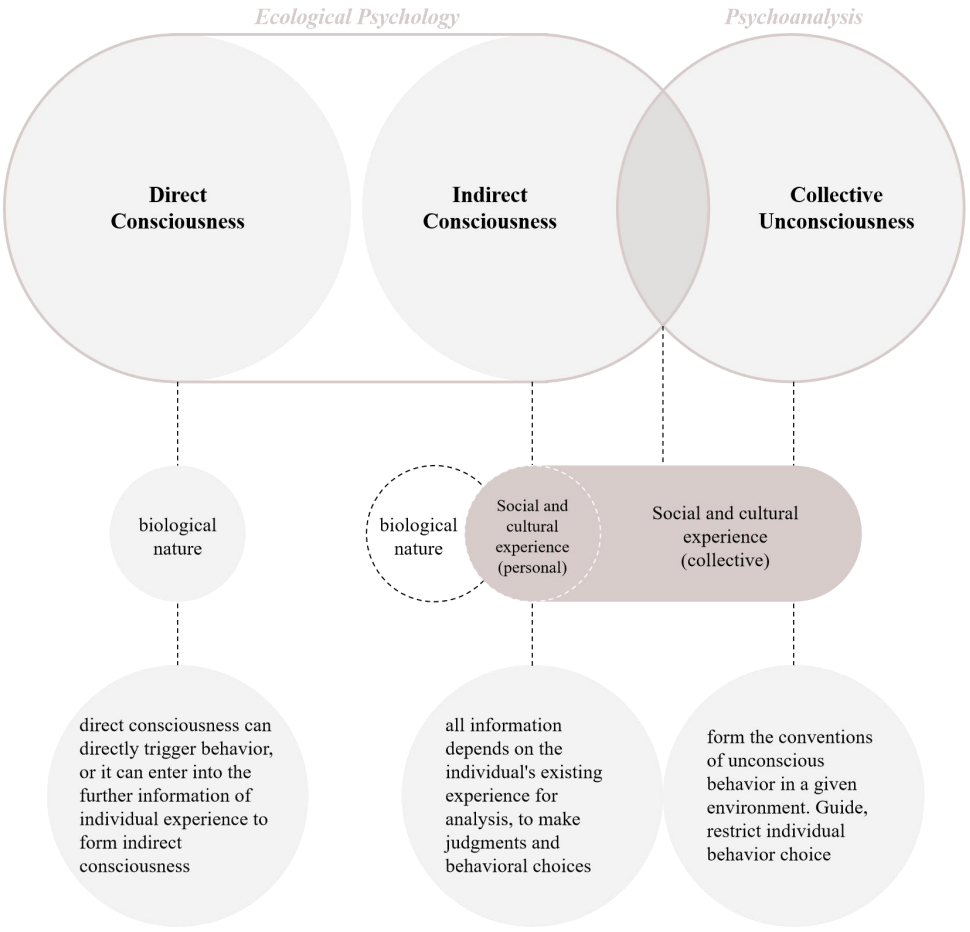


Figure 2.4 The relationship between direct consciousness, indirect consciousness and the collective unconsciousness

From a human perspective, direct consciousness is generated by the biological nature of humans directly responding to stimuli provided by objects in the environment. When the stimuli provided by the environment are insufficient, the intervention of personal experience transforms direct consciousness into indirect consciousness. Discussions on the collective unconscious take place in a different academic field than those on direct and indirect consciousness. However, there are some intersections between the findings of these two different domains. Similar to indirect consciousness, the emergence of the collective unconscious is also due to the intervention of sociocultural experiences. The difference is that the sociocultural experiences discussed in indirect consciousness are from an individual perspective, while the collective

unconscious explores the impact of sociocultural experiences on unconscious behavior from the perspective of the human collective.

From the perspective of product interaction, any product is meant to serve the public. Indirect consciousness focuses on an individual's sociocultural experiences, which can vary greatly due to differences in personal growth experiences, cultural backgrounds, etc. Therefore, if unconscious behavior in product interaction is considered from the perspective of indirect consciousness, it is difficult to form a product interaction design that is universally applicable to the public. In contrast, direct consciousness's consideration of human biological attributes and the collective unconscious's consideration of group sociocultural experiences are more universally applicable to product interaction design. Therefore, this study will focus on the two types of unconscious behavior in product interaction: direct consciousness and the collective unconscious. Indirect consciousness will not be included in the analysis of this study.

2.3.2 The Cause of Users' Unconscious Behavior in Product Interaction

This section will use cases to analyze the causes of two types of unconscious behaviors of users during product interaction. In the context of product interaction, the following article will discuss direct consciousness and collective unconscious as two categories of unconscious behavior.

2.3.2.1 Users' Unconscious Interaction Behavior Resulting from Direct Consciousness

- **Direct Consciousness Stimulated by Sensory Input**

During product interaction, users' direct consciousness and unconscious interaction behaviors are particularly prominent in flat products designed with visual illusions. The theory of visual consciousness suggests that visual stimuli need to be presented in three-dimensional space to be fully realized. However, flat design, by restricting the source of three-dimensional visual stimuli, can subjectively create stimuli that can be directly perceived. When these stimuli create a chaotic contradiction with real-world experiences, it results in the creation of visual illusion designs.

Figure 2.5 BULBING 2D/3D LED lamp (Plazmalab, 2024)

For example, Figure 2.5 shows the BULBING 2D/3D LED lamp designed by Studio Cheha, composed of a flat light network made of LEDs and light-guiding devices. This design leverages visual illusions to create a misleading direct consciousness for users. When viewed from the front, users might unconsciously perceive it as a three-dimensional light bulb-shaped lamp and engage in unconscious interaction behaviors, such as rotating it. Visual illusion designs create this misleading direct consciousness, allowing users to experience the contradiction between their direct consciousness and the real world, thereby deriving enjoyment from the product interaction. In such products, objects in the environment trigger unconscious behaviors through

sensory stimuli, like vision and hearing, leading users to form a direct sensory consciousness (Figure 2.6).

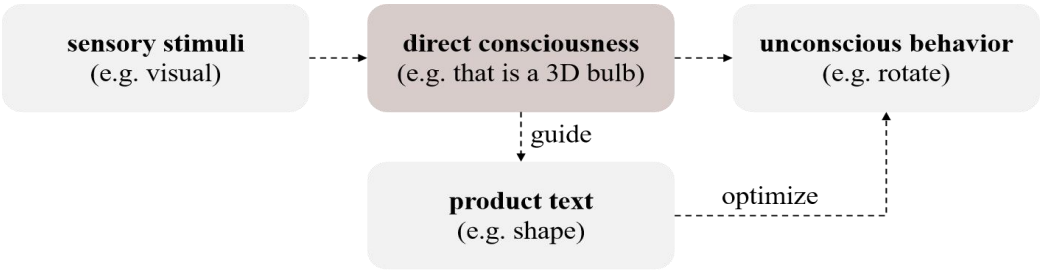


Figure 2.6 Direct unconscious interaction based on sensory stimuli

■ Direct Consciousness Stimulated by Physiological Reflexes

Some infant product designs leverage the physiological reflex known as the palmar grasp reflex. The palmar grasp reflex is one of several neonatal reflexes present at birth, allowing infants to close their fingers around an object placed in their palms (Geddes, 2021). When an object is placed in an infant's hand, they will naturally grasp it, which is a form of direct consciousness. For example, Figure 2.7 showcases a series of infant soothing toys designed to take advantage of the direct consciousness generated by the infant's palmar grasp reflex, with shapes that are easy for infants to grasp. This design accommodates the unconscious product interaction behavior of 'grasping' in infants, providing them with a good interactive experience.

Figure 2.7 Baby comfort toy (Babynest, 2024)

In the product interaction process of such products, objects in the environment stimulate the user's physiological reflex mechanism through physical contact. The physiological reflex, as a form of direct consciousness, will trigger unconscious behavior (Figure 2.8).

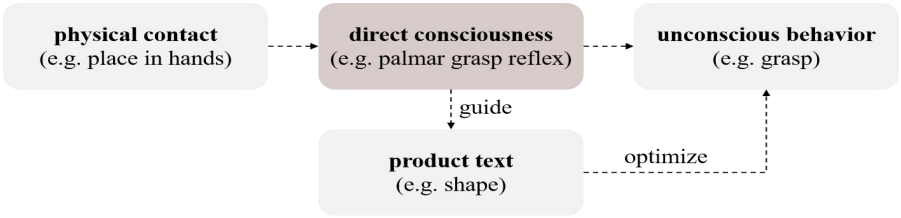


Figure 2.8 Direct unconscious interaction based on physiological reflexes

2.3.2.2 Unconscious Interaction Resulting from Collective Unconsciousness

- **Collective Unconsciousness Arising from Daily Habits**

Japanese designer Kotaro Usukami (2015) observed that people tend to lean back and sit deeply in a chair when they are relaxed, but sit on the front third of the chair when engaged in conversation, to facilitate attentiveness. This is a form of collective unconscious, an archetype formed through the accumulation of experiences in social interactions. Kotaro Usukami modified such unconscious interaction behaviors and designed a chair called 'KEY' (Figure 2.9). He changed the front third of the chair's seat to red, which not only meets the sitting posture requirements for different scenarios but also serves as an indicative sign with the red color.

Figure 2.9 KEY chair (Kotaro, 2015)

In such product interaction processes, users' accumulated life experiences form a collective unconsciousness archetype. When similar scenarios arise, users' collective unconsciousness archetype is awakened, leading to unconscious interaction behaviors between the users and the product (Figure 2.10).

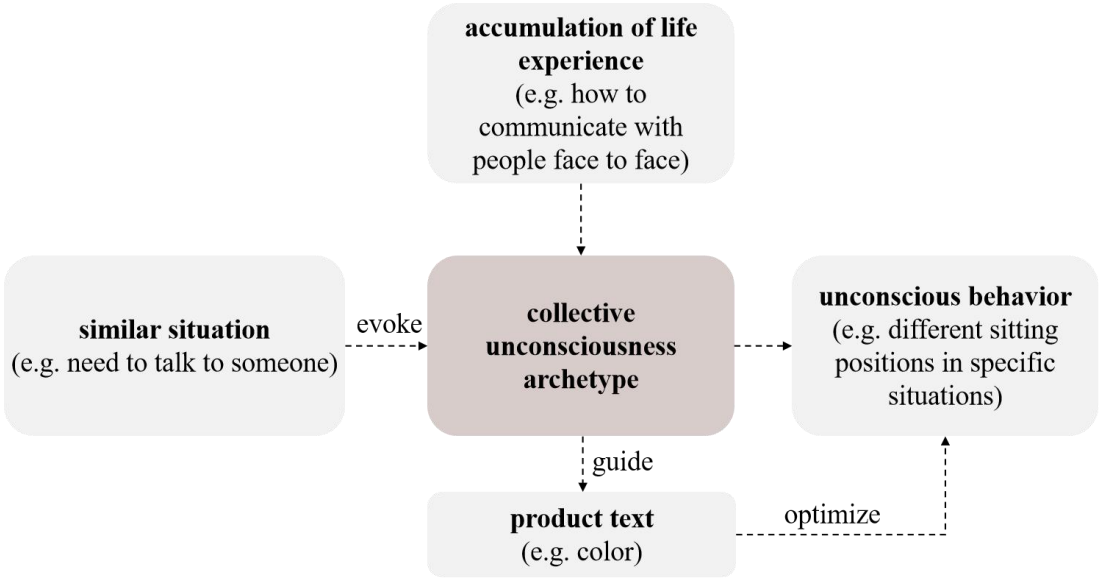


Figure 2.10 Collective unconscious interaction based on daily life experience

■ **Collective Unconsciousness Arising from Cultural Customs**

In Chichibu City, Japan, 'Fireworks Festival' is everywhere. At dusk during the festival, residents of the city traditionally gather on rooftops or high places to enjoy the fireworks. Designer Nendo incorporated this local tradition into his housing designs by creating a large glass ceiling on the second floor facing the direction of the fireworks display, allowing residents to view the spectacular fireworks through the glass (DIVISARE, 2015). Nendo named this design 'Firework House' (Figure 2.11).

Figure 2.11 'Firework House' (DIVISARE, 2005)

From this work, it can be seen that watching the fireworks display during the annual Fireworks Festival has become a collective unconscious behavior for the residents of Chichibu City. This behavior is imbued with the psychological expectation of being able to enjoy the fireworks from the comfort of their homes. The designer responded to this latent psychological need with the innovative design of the 'glass ceiling.' When residents watch the annual fireworks display through the glass ceiling of the attic, their collective unconscious is stimulated, bringing a profound sense of satisfaction. In this product interaction process, the local traditional cultural customs form a collective unconscious archetype. When similar scenarios arise, the users' collective unconscious archetype is awakened, leading to unconscious interaction behaviors between the users and the product (Figure 2.12).

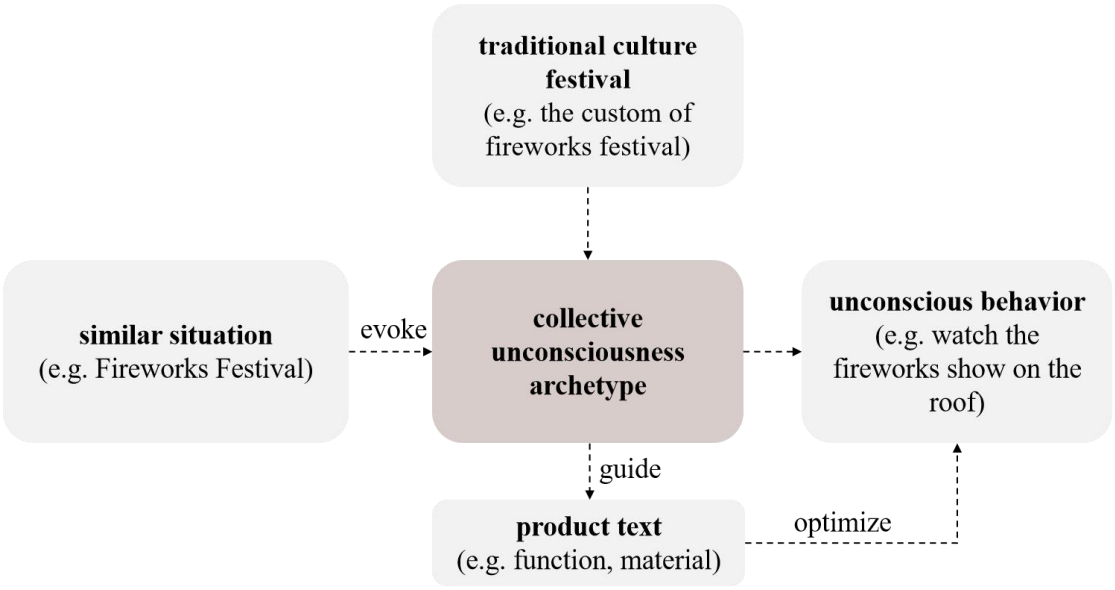


Figure 2.12 Collective unconscious interaction based on culture custom

2.3.3 Values of Users' Unconscious Behavior to Product Innovation

2.3.3.1 Use Users' Direct Consciousness to Reduce Cognitive Load During Product Interaction

According to Ecopsychology's theory, direct consciousness in product design means starting from the user's initial cognition of the product, to comprehensively supplement product design activities. This approach acknowledges the importance of how users initially encounter and understand a product, emphasizing the need for intuitive designs. Starting from users' unconsciousness, designers can reduce the cognitive load brought by products to users (Belvedere et al., 2013) and make product interaction return to user intuition.

Product interaction design driven by users' direct unconsciousness emphasizes viewing users as individuals with biological attributes and situating them within the product usage environment to explore the formation of consciousness and its symbolic expression. This theoretical framework not only addresses the mechanisms of consciousness formation within the environment but also explores the dynamic interactions between individuals with biological attributes and their surroundings, as well as the interplay between environmental factors and

human behavior. This interplay reveals psychological and behavioral phenomena characterized by functional tendencies (Hu, 2012). The application of 'direct consciousness' can connect users' biological and experiential attributes to cultural signs. The specific process is shown in Figure 2.13.

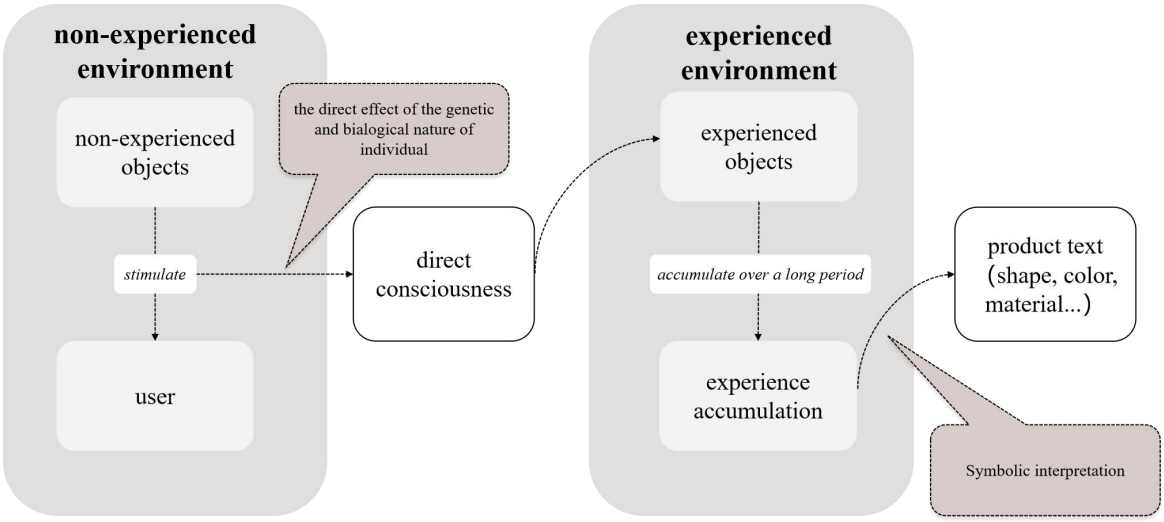


Figure 2.13 The process of using users' direct consciousness in product interaction design

Firstly, in a non-experienced environment, non-experienced objects provide users with sufficient stimulation to form direct consciousness. When direct consciousness enters the user's experienced environment, the user analyzes and judges it based on their accumulated life experiences, forming indirect consciousness. Secondly, in specific design activities, the formed experiences are symbolized and then used to interpret a sign within the product system, forming the product text.

2.3.3.2 Awaken Users' Collective Unconscious Archetypes to Trigger Natural Interaction

In Psychoanalysis, Jung's interpretation of collective unconsciousness archetypes is crucial for understanding how to utilize users' unconscious behavior in product interaction design. It clarifies that the experiential process of collective unconscious archetypes is inherently meaningless. The integration of product operation and use with sociocultural experiences becomes the impression users have of a product. When these experiences repeat within

sociocultural life, they transform into signs, with archetypes existing in this symbolic form (Balapala, 2014). The symbolization of the collective unconscious is an individual's interpretation of the meaning of archetype experiential outcomes. Thus, using users' unconscious behavior in product interaction design is not about the collective unconscious archetypes themselves having symbolic meaning, nor is it about the direct symbolization of collective unconscious archetype experiences. Instead, it involves designers providing necessary information within the product system environment that can awaken the collective unconscious archetypes of the user group (Zhang, 2022). In this process, designers, as individuals outside the user group, bring their personal unconscious into product design activities. The original characteristics and ideas of these complexes are retained, yet they are also influenced by the collective unconscious of the user group. When the designer's personal unconscious complexes conflict with the collective unconscious norms of the user group, the designer's personal complexes either transform under the influence of the group's collective unconscious norms or are not understood by the group norms, failing to transmit meaning within the group (von Franz, 2016).

Product semantics posits that for the effective transmission of design intentions, the effective conveyance of product text meaning must occur within a system specifically divided by cultural contexts and populations (Chandler, 2022; Hjelm, 2002). Levi-Strauss, through anthropological research methods, proposed that the collective unconscious aggregates are what compose and sustain the system structure of a group within an environment. The collective unconscious establishes the regulatory foundation within the product design system of the product user group. This is because every product serves a group within a sociocultural environment, not individuals within the group, but broadly serves the populace of its group.

Zhang (2022), analyzed the product design system based on the collective unconscious as the regulatory foundation (Figure 2.14), which consists of 'the collective unconscious of the user group,' 'context,' 'the capacity of the designer' (including the designer's personal complexes, cognitive experiences, cultural cultivation, and other privatized qualities), 'elements carried by the product itself,' and 'the capacity of users' (including users' personal complexes, cognitive experiences, cultural cultivation, and other privatized qualities) (p. 137).

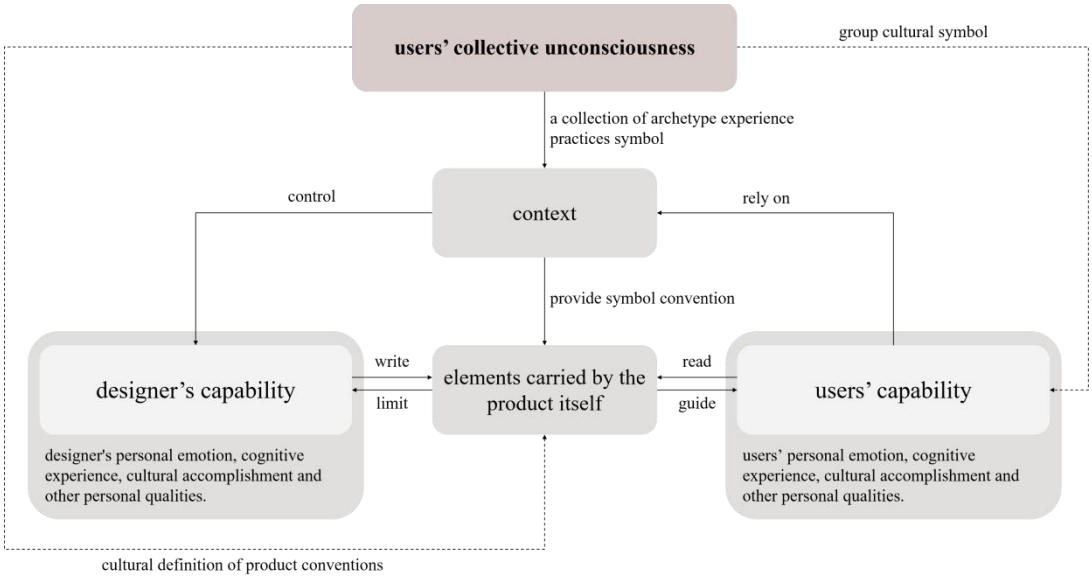


Figure 2.14 Product design system based on the collective unconscious. Adapted from (Zhang, 2022)

Within this system, the collective unconscious serves as the source and foundation for constructing various elements, where context represents a collection of symbolized experiences and practices regarding the product formed within the collective unconscious of users. These symbolized collections constitute the basic regulations for product design. Context controls the designer's capability, and users also rely on it to interpret the products designed by the designer.

The elements carried by the product itself represent the general understanding and definition of the product within the collective unconscious of users. It draws a picture of the content and

direction of the design for the designer while also guiding users on how to understand the product.

The users' capability is determined by the collective cultural signs of users. Although the group consists of many individuals, individual cognitive experiences, cultural cultivation, and personal emotions are selectively filtered through the collective unconscious archetypal experiences. Parts that do not align with the collective unconscious's value concepts and cultural orientations are discarded.

The designer's capability can be viewed as the 'intervener' in the product design system. It refers to the designer's ability when designing products, including personal emotions, cognitive experiences, cultural cultivation, and other personal qualities. These qualities are all controlled by the elements within the system. The method of product design, influenced by elements within the system, is the specific design method employed by the designer.

In summary, psychoanalytic studies on the collective unconscious are crucial for the construction of design methods driven by users' unconscious behavior. Firstly, the collective unconscious of users provides a source of unconscious symbolic regulations for design. Secondly, the collective unconscious of users lays the foundation for constructing the design system.

2.4 Without Thought Design

2.4.1 The Origin and Concept of Without Thought Design

In the book *The Senses Considered as Perceptual Systems* , Gibson (1966) introduced the concept of 'Affordance' to denote the use value of environmental objects based on the inherent physical characteristics of creatures. He used this concept to explain the connection between user behavior and the material characteristics of products. With Norman (1988) bringing it into the design field, 'affordance' has become a means to enhance product visibility and usability.

Influenced by the concept of 'affordance' and the prevalence of the Bauhaus design philosophy of 'Less is More,' the Japanese industrial designer Naoto Fukasawa criticized the overemphasis on visual and other sensory stimulations in Japanese product design at the time. This approach forced users to pay attention to unnecessary information, losing their subjective experience (Takeshi et al., 2016). To remove unnecessary design elements that add to the user interaction burden and achieve a more intuitive and transparent product interaction experience, Naoto Fukasawa (2006) initiated an innovative workshop called 'Without Thought' in 1998. This workshop focused on discovering creativity in people's unconscious behaviors and integrating these concepts into product design.

The concept of *Without Thought Design* can be explained from a psychological perspective. The idea of the 'unconscious' traces back to Freud's psychoanalytic theory, which posits the unconscious as a biological instinct in opposition to human rational thought. According to Freud, the unconscious serves as a repository for habitual experiences and those that have been forgotten, forming what he called the 'iceberg theory,' where the unconscious is the part submerged below the surface (Green, 2019). Building on Freud's work, Swiss psychologist Carl Jung introduced concepts such as the ego, personal and collective unconscious, intuition, instinct, and archetypes. These elements interact to shape human behavior and experience (Jung & De Laszlo, 2021). Jung's concepts expanded the understanding of unconscious processes. The personal unconscious refers to an individual's biologically innate instincts and experiences that are not easily recognized. In contrast, the collective unconscious represents a common repository of universal experiences and signs inherited from our ancestors (Hauke, 2012). Intuition, instincts, and archetypes are fundamental elements that interact within the psyche to influence thoughts, behaviors, and consciousness (Hogenson, 2009).

Linking Naoto Fukasawa's *Without Thought Design* with psychological theories, a common theme emerges, emphasizing the role of the unconscious in human behavior, experience, and the creative process. Just as Jung highlighted the importance of intuition and instinct in shaping human behavior, '*Without Thought Design*' leverages these unconscious behavioral elements as drivers in product design. This approach underscores the significance of understanding and integrating unconscious actions and reactions into the design process, aiming to create products that resonate more deeply with users by aligning with their instinctual uses and needs.

2.4.2 The Disciplinary Foundations of *Without Thought Design*

After decades of development, the concept of *Without Thought Design* has transformed from a mere workshop theme into a design methodology. This evolution couldn't have happened without backing from multiple fields related to the activities of *Without Thought Design*. Fields like ecopsychology and psychoanalysis have provided deep insights into human unconscious behaviors, linking these insights to design principles through the concepts of product semantics and syntax. The next sections will explore each related field more deeply. These areas are closely linked in the creation of the *Without Thought Design* approach.

2.4.2.1 Product Semantics and Product Syntax

'Product semantics' and 'product syntax' represent two branches of semiotics within product design. Both *Without Thought Design* and semiotics concentrate on two key issues: firstly, the process by which signs acquire their meanings; and secondly, how the characteristics of one sign are interpreted through the consciousness of another. Corresponding to these issues, there are two major types of *Without Thought Design*: 'objective sketching' and 'found objects' (Zhang, 2022). 'Objective sketching' addresses how signs' meanings are generated within a product system, whereas 'found objects' deal with how signs within a product Are rationalized through

interpretations by external cultural signs. The advancement of semiotic theory and tools has rendered *Without Thought Design* a potent approach for systemic design.

In *Foundations of the Theory of Signs* published by Charles Morris in 1938, semiotics was divided into three areas: syntax, semantics, and pragmatics. Syntax focuses on the structure and interpretive relationships between signs; semantics examines the meaning of signs in relation to objects or things (cited in Warell, 2003); and pragmatics explores the relationship between signs and their interpreters, essentially their practical application or experience (Krippendorff & Butter, 1984). The integration of semiotic theory with product design research led to the development of product syntax and product semantics, both playing a significant role in the formation of *Without Thought Design* theories and methods. Since pragmatics concentrates on the application relationship between signs and users, the combination of product design and pragmatics tends to be more about practical research. Compared to product semantics and product syntax, pragmatics does not significantly contribute to the development of theories and methods for *Without Thought Design*. Therefore, this chapter will specifically discuss product semantics and product syntax.

Product semantics, developed by Krippendorff and Butter in 1984, is defined as the study of the symbolic qualities of man-made forms within cognitive and social contexts. Its role in product design begins with endowing product design with a textual perspective, treating the shape, form, color, and texture of products as the product's symbolic text (Zhang, 2022). Every product, intended to convey and express the designer's intention, can be considered a sign. A product is a carrier of meaningful symbolic text, and product design is a process of signification, whether aimed at function or emotion, serving as a way for designers to express intentions to

users (Crilly, 2011). The design intentions that designers wish to communicate are the meanings expressed by the product's symbolic text.

Furthermore, product semantics explores how the meaning of product symbolic texts is generated and how this symbolic text becomes 'meaning' upon being received by an interpreter. Peirce believed that the meaning of any sign must be explained through another sign (Liszka, 1996). This principle also applies to product design signification; to convey a meaning, a sign outside the product text must be found, and through mutual explanation, the purpose of signification is achieved (Hjelm, 2002). Peirce referred to this process of direct mutual explanation between two signs as 'rhetoric' (cited in Bergman, 2009). It is evident, then, that the two basic categories of 'objective sketching' and 'found objects' in *Without Thought Design* are based on product semantics, exploring the interpretation and interrelationship of symbolic texts within and outside the product. In product semantics, there are two terms, metaphor and archetype, which are very similar to 'objective sketching' and 'found object'.

Metaphor:

- Meaning: Metaphor is a rhetorical device used to convey a concept or characteristic through comparison or analogy. In product design, metaphor can be used to imply or express a particular meaning or feeling through the shape, structure, functionality, or other features of a product.
- Application: Designers can use metaphor to make products easier to understand or use by linking familiar concepts or images with product features, thereby enhancing the visual or perceptual impact of the product.

Archetype:

- Meaning: Archetype refers to fundamental patterns or original images that are universally recognized across cultures and time. In product semantics, archetypes are perceived as universal cognitive patterns or symbols that transcend cultural and temporal boundaries.
- Application: Designers can use archetypes to evoke emotional resonance and a sense of identification among users. By incorporating design elements or features that resonate with specific cultural or psychological symbols, designers can enhance the meaning and user experience of the product.

Unlike semantics, which deals with the relationship between signs and meanings, syntax examines the logical structure of the rhetorical relationships between one sign system and another (Krippendorff & Butter, 1984). The study of syntax, however, covers a broad area. Product syntax applies Morris's concept of syntax to the field of product design, analyzing the rhetorical and organizational structure between an external cultural sign system and the product's internal sign system. The study of sign structures dates back to structuralist semiotics, which evolved from Saussure's linguistic semiotics (Zhang, 2022).

Saussure's semiotics matured in the early 20th century and provided a solid theoretical foundation for the rise of structuralism (Joseph, 2022). Saussure's theory of semiotics emphasizes a priori conventions as the premise for the sender and receiver to transmit meanings of signs. These a priori conventions refer to rules or agreements that exist before communication and are mutually recognized by both parties involved. They form the basis for the effective transfer of textual meanings. This is the theoretical foundation of structuralist semiotics, which posits that the meanings of language and other sign systems are determined by these fixed rules and structures (Holdcroft, 1991). Saussure divided the sign into the signifier (the form which the sign takes) and the signified (the concept it represents).

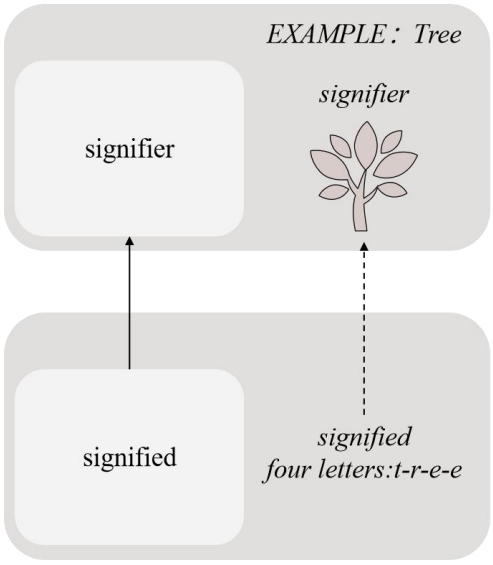


Figure 2.15 Signifier and signified in Saussure's Semiotics

The signifier and the signified are inseparable; together, they form the basic unit of language—the sign (Mehlman, 1972). Concurrently, Peirce offered a novel understanding of the structure of signs. Peirce believed that cognition, thought, and even humans themselves are fundamentally symbolic. He divided a sign structure into three parts: the 'object,' the 'signifier,' and the 'interpretant' (Eco, 1976). This triadic relationship forms the core of Peirce's semiotic theory, distinguishing it from Saussure's dyadic structure of signification.

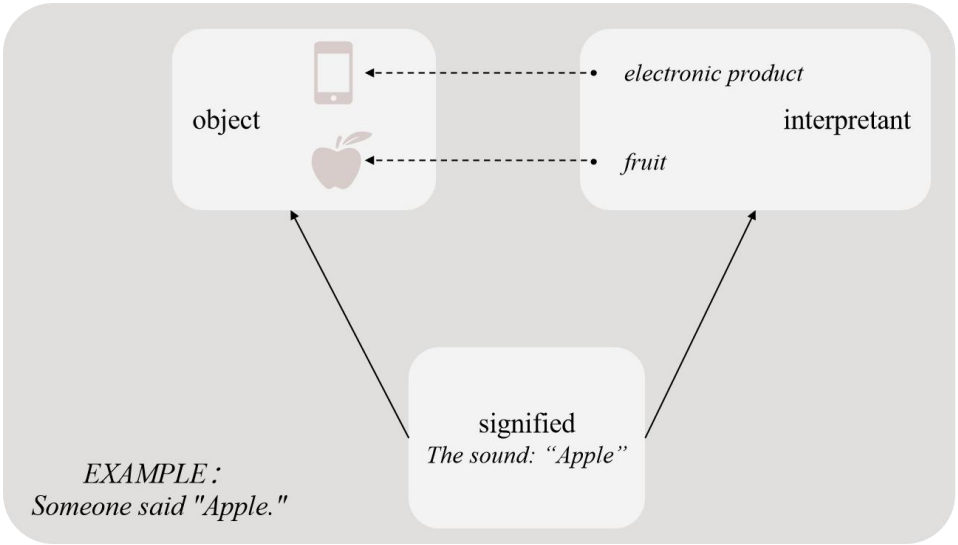


Figure 2.16 'Object', 'signified', 'interpretant' in Peirce's Semiotics

In this context, 'signified' specifically refers to the perceptible qualities of an object, while 'object' refers to the thing itself. 'signified' and 'object' together constitute the referential relationship of the sign, and the understanding of 'interpretant' must be obtained through the interpretation of this referential relationship (Zhao, 2016). The introduction of 'interpretant,' along with the separation of the thing itself from its perceptible qualities into 'object' and 'signified,' represents a significant contribution of Peirce to semiotics. On one hand, by separating 'object' from 'interpretant,' the interpretation of a sign is no longer solely dependent on the sign itself but also on the interpreter's cultural background and personal experience. Different individuals facing the same sign might derive different 'interpretant' meanings based on their respective cultural conventions. On the other hand, the separation of 'object' and 'interpretant' breaks away from the presupposed structural regulations of Saussurean structuralist semiotics, where the 'object' must rely on experiential information provided by different system environments to obtain meaning interpretation. Peirce's semiotics emphasizes the exchange of information and interprets the meaning of signs beyond structural constraints. By positioning the interpreter at the core of sign transmission, he reflected on the limitations and closed nature of traditional structuralism, laying the theoretical groundwork for post-structuralism (Moon, 1990).

The semiotic theories of Saussure and Peirce form the foundational pillars of the semiotic theoretical framework, both contributing significantly to the formation of product syntax. Their methodologies for deconstructing sign structures offer diagrammatic tools for analyzing the logic behind the rhetorical relationships between two sign systems in product design. The emergence of *Without Thought Design* as a scientifically effective method of design is inseparable from product syntax's role in conveying the meanings of product symbolic texts and analyzing the deep mechanisms of rhetorical interpretation between two sign systems.

In summary, product semantics and product syntax play a crucial role in the establishment of *Without Thought Design* theory. During the construction of *Without Thought Design* methods, product semantics and product syntax are intertwined, each indispensable to the other. Relying solely on product semantics would limit *Without Thought Design* to discussions on the interpretation and effectiveness of product symbolic texts and rhetorical meanings, without the ability to analyze the various methods of signification and transformation from a structural level. Product syntax is required for dissecting the underlying logic at the structural level. Moreover, the study of product syntax depends on the rational interpretation of product symbolic texts and rhetoric provided by product semantics. Essentially, the nature of product syntax research is a structural analysis based on the interpretations of meanings between signs offered by product semantics. Through this analysis, it is possible to uncover universal principles of sign interpretation, thereby forming a universally applicable method of *Without Thought Design*.

2.4.2.2 Universal Rhetoric in Peirce's Semiotics

In his study of semiotics, Charles Peirce (1992) proposed a classification for universal rhetoric. He argued that all thinking processes could be seen as understanding the meaning of one sign through the interpretation of another, and universal rhetoric is precisely the study of how signs explain each other. Within this framework, rhetoric is viewed as a form of metaphor in a broad sense. American literary theorist Jonathan Culler noted that metaphor is a fundamental way through which we comprehend the world, helping us understand something by viewing it as something else (cited in Moran, 1989). According to the theory developed by critic and rhetorician I. A. Richards (1936) in his book *The Philosophy of Rhetoric*, a complete metaphor consists of two parts: *'vehicle*' and '*tenor*.' The 'vehicle' represents the familiar, concrete cultural life experiences and concepts, which are our intuitive and rich consciousness of the world. The '*tenor*,' on the other hand, represents the abstract entities that we are attempting to understand,

often difficult to describe or comprehend directly (cited in Steen, 1999). Peirce (1992) described the process of metaphor as follows: firstly, a familiar, concrete entity (*vehicle*) corresponds in some illustrative form to a more abstract concept (*tenor*) that someone is trying to understand. Then, through the interpretation and understanding of the symbolic meaning of the familiar entity (*vehicle*), one gains a clear consciousness of the abstract concept (*tenor*).

In the context of product design, Peirce's universal rhetoric theory indicates that any writing of product design text is a rhetoric between signs and the product text. The rhetorical methods of expressing product design text mainly include five types: simile, implied metaphor, metonymy, synecdoche, and irony.

Simile： The physical or qualitative similarity between signs

Implied Metaphor：Psychological similarity between signs

Metonymy：Proximity between signs

Synecdoche：The part replaces the whole in the sign

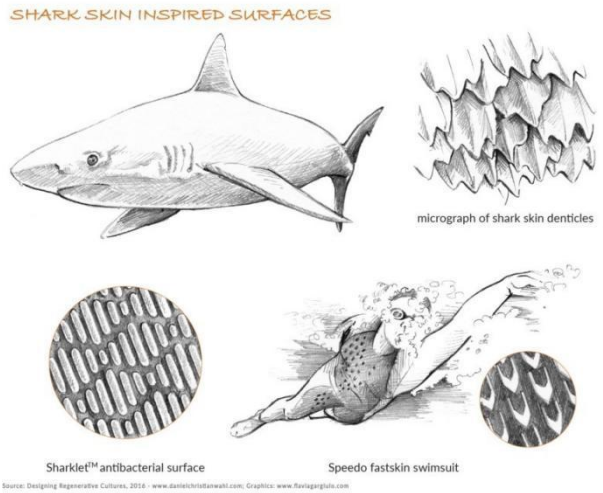
Irony：The part of a sign negates the whole

The interpretations of metonymy and synecdoche both rely on the Gestalt psychology's principle of perceptual organization (Willerton, 2005). As a result, metonymy and synecdoche are often used interchangeably in the signifying activities of product texts. This blending is due to the way our minds tend to fill in gaps and create whole forms from partial information, a core aspect of Gestalt theory that influences how we perceive and interpret relationships between different elements within a product's design.

In cross-linguistic rhetoric activities, there will inevitably be differences in channels and mediums between '*vehicle*' and '*tenor*,' leading to a relationship that transcends the symbolic form, creating conceptual rhetoric. Conceptual rhetoric involves the conceptual connection of '*vehicle*' and '*tenor*' across mediums and channels (Lakoff & Johnson, 2008). In product design, all rhetoric falls under conceptual rhetoric, where the external system's '*vehicle*' sign (such as a design element) and the product's own '*tenor*' sign (such as a product feature) are freed from the confines of traditional rhetoric. They connect through the users' unconscious cognition, unaffected by the medium or channel of communication. Rhetoric in product design achieves a harmonious interpretation of concepts and perceptual meanings across different fields.

The rhetorical interpretation of product text by designers is a nature of all design activities (Iannilli et al., 2019), enhancing the communication between products and sociocultural contexts, and expanding the types of new consciousness and conceptual categories associated with products. Zhang (2022) categorizes the mutual rhetoric between signs and products into two directions: signs serving products, and products serving signs (see Table 2.1).

Table 2.1 Two rhetorical directions between sign and product

Sign serves product	'tenor': product text 'vehicle': signs outside the product
	*Using the characteristics of shark skin that can reduce resistance in water as a 'vehicle', describing the swimsuit made by imitating shark skin ('tenor') can help swimmers reduce resistance and increase speed.*
Product serves sign	'tenor': signs outside the product 'vehicle': product text

The use of materials that are degradable in the product itself (the 'vehicle') serves to express a call for ecological and environmental protection (the 'tenor').

2.4.2.3 Related Design Principles

- **Kansei Engineering**

Kansei Engineering is the fusion of sensitization and rationality, the combination of sensitization and engineering technology, through the analysis of human emotional needs to design products, by quantifying human preferences to manufacture products (Nagamachi, 1995). In 1970, researchers at Hiroshima University in Japan began trying to fully consider the mood and needs of residents in residential design, a technique then known as 'emotional engineering' (Schütte, 2005), which, after nearly two decades of research, was gradually accepted and applied as perceptual engineering.

Similar to *Without Thought Design*, Kansei Engineering emphasizes considering users' feelings and experiences during the design process. Both approaches aim to deeply understand users' inner needs and preferences to create more attractive products. However, Kansei Engineering focuses more on using quantitative techniques to analyze and study user consciousness and employs statistical methods to explore which products better suit users' emotional needs (Nagamachi, 2002). The product design method based on Kansei Engineering includes the following steps: setting goals, collecting emotional terms, evaluating emotional terms, quantifying them through engineering means, and obtaining results (Figure 2.17). In these steps, designers define and code the morphological characteristics of the product, combine the results of intention scoring, and establish the correspondence between product intentions and

morphological characteristics using statistical analysis methods. In this process, designers often overlook cultural and individual differences in the mass data analysis and generalize the data interpretation in the process of quantifying user emotions, which carries the risk of essentialism proposed by Karl Popper. Essentialism suggests that any entity has some essential essence, and once the essence of things is understood, the truth can be grasped and possessed, and the motive and reason of objective facts can be explained (Hull, 1965). This might lead to neglecting the demand differences of users due to the cross-sources of product usage experience (cultural customs, living environment, etc.). On the other hand, *Without Thought Design* directly mines user consciousness through the existing behaviors of users using the target product, collects the needs in users' subconscious, and maps them to the product text, reducing the loss of latent variables during the quantification process.

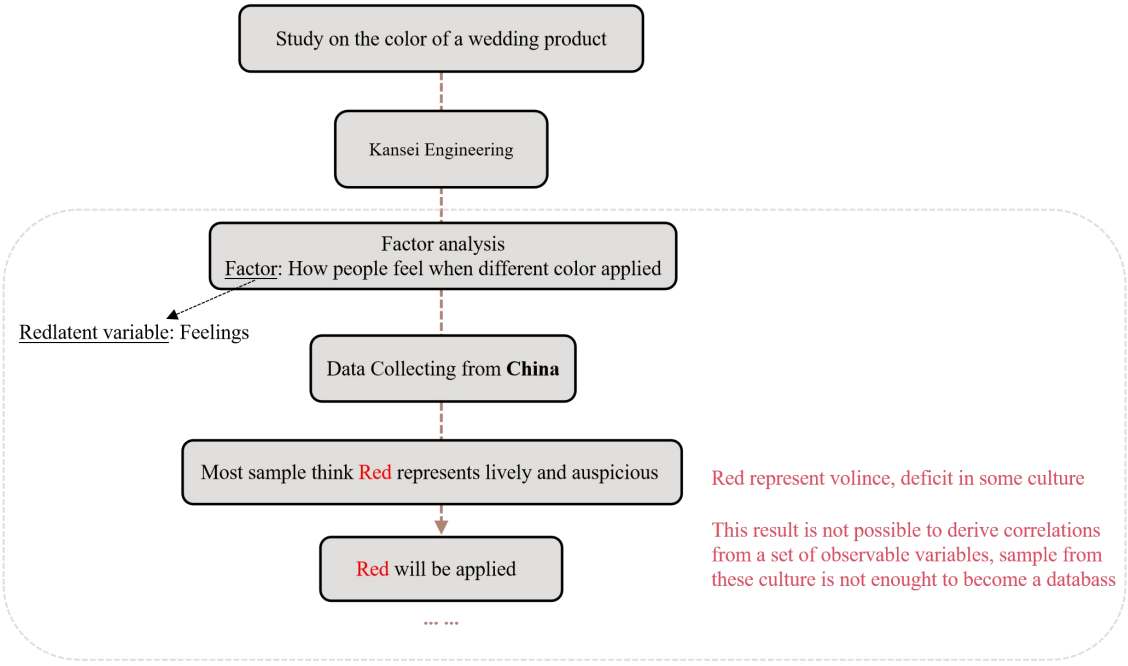


Figure 2.17 Product design method based on Kansei engineering

- **Emotional Design**

Emotional Design, proposed by Donald Norman, revolves around the concept of creating products that evoke emotional memories, thereby fostering positive user experiences (Van Gorp

& Adams, 2012). The designer's goal is to engage users at three cognitive levels: visceral, behavioral, and reflective, aiming to create products that elicit positive emotional responses from users (Ho & Siu, 2012).

Emotional design is considered a design approach that can significantly affect user experience. Firstly, designing products with emotional appeal can establish deeper connections between users and products. When users feel an emotional connection, they are more likely to have a positive experience and develop loyalty towards a brand or product. For example, Apple's products, with their stylish designs, intuitive interfaces, and the identity signs associated with Apple products, create deep emotional bonds. Many Apple users are not just loyal; they are passionate advocates of the brand (Figure 2.18).

Figure 2.18 Apple product (Jobs, 2018)

Secondly, products that evoke positive emotions are often perceived as easier to use. Emotional design can make users more tolerant of minor usability flaws and can increase overall satisfaction with the product. For example, Philippe Starck's Juicy Salif (lemon squeezer) shows that through usability studies, this product is almost not functional as a lemon juicer (van der Linden et al., 2012). However, the purpose of the product is not to provide consumers with a convenient and efficient juicing experience, but to serve as a piece of art that can attract consumers and provide emotion though its form (Figure 2.19).

Figure 2.19 Juicy Salif (Sha, 2021)

Similar to *Without Thought Design*, Emotional Design also recognizes that design is not just about fulfilling functional needs but is about creating an experience that resonates with users. The difference lies in that Emotional Design focuses more on the emotional connection between the product and the user. Emotions are abstract and vague, developing from the individual's or group's unconsciousness, and can only be excavated through abstract intention scales (Greenberg & Safran, 1989), then reprocessed from the designer's subjective perspective. Some products designed through this method are endowed by designers with overly strong formal expressions, which, while resonating with users on a simple emotional level, also affect the users' objective cognition of the product, burdening them. Excessive emotionalization can alienate users. Therefore, the success of Emotional Design highly depends on the designer's grasp of user emotions. In contrast, the resonance created by *Without Thought Design* comes from the user's unconscious behavior. Compared to abstract emotions, behavior is tangible, and what designers need is the ability to perceive unconscious behavior.

- **Affordance**

Affordance is what the environment offers the individual. James J. Gibson coined the term in his 1966 book, *The Senses Considered as Perceptual Systems*, and it occurs in many of his earlier essays.

In design, Affordances are the possible actions a person can perform with a particular object/product. For example, a chair affords sitting. If an affordance cannot be easily perceived by a user, a means of signaling its presence is required. Affordances determine what actions are possible (Norman, 1999).

The Norman door is a door with a design that makes it difficult to determine the correct way to open the door (Figure 2.20). A so-called 'Norman Door' has design elements that give the wrong usability signals to the point that special signage is needed to clarify how they work. Without signs, a user is left guessing about whether to push or pull, creating needless frustration. The 'Norman door' dilemma can be seen in the design of many other everyday items, and even more so in the design of software and website interactions.

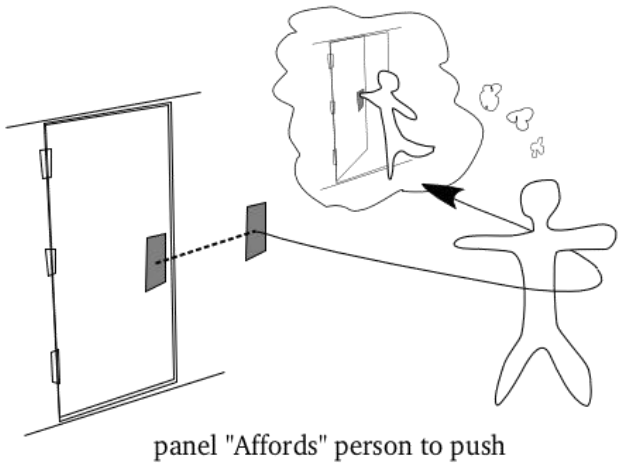


Figure 2.20 Norman Door

- **CMF Design**

Designers not only design the shape of products to express product semantics but also employ materials, colors, and textures. CMF design is a subdivision of industrial design, where

C stands for Color, M for Materials, and F for Finishing. CMF design encompasses aesthetics, colorology, engineering, materials, psychology, and more, representing a cross-disciplinary amalgamation of trends, process technologies, innovative materials, and aesthetic concepts (Liu, 2020). Based on the same product shape, differences in CMF design can give a product an entirely new definition. In *Without Thought Design*, Naoto Fukasawa also utilized CMF design to impart different semantics to products. For example, in his 2004 packing design—juice skin (Figure 2.21), he used different CMF from the original fruit to represent the corresponding taste of juice. By leveraging users' direct consciousness of fruit, he reprogrammed the product semantics through CMF design. Most CMF designs are still created based on the designer's direct definition of the product, whereas CMF design in *Without Thought Design* establishes a relationship between users' unconscious cognition and the product's emotional needs. From a semiotic perspective, the thinking behind CMF design also belongs to the writing of product texts. Compared to *Without Thought Design*, CMF focuses more on setting the trend of the product through text writing; in some projects, it also guides the direction of writing for *Without Thought Design* texts.

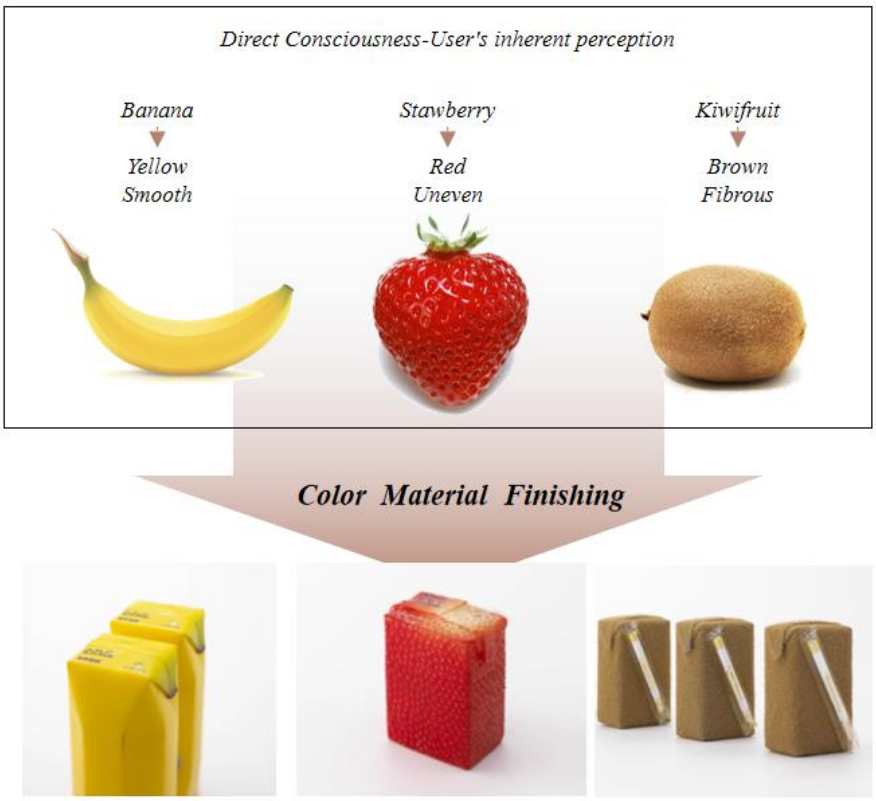


Figure 2.21 Juice Skin

2.4.3 Types of *Without Thought Design* in Product Interaction Design

Naoto Fukasawa divides *Without Thought Design* into two fundamental types: *'objective sketching*' and *'found objects*.' '*Objective sketching*' refers to an objective portrayal of user behavior and psychology within the product's usage environment (Takeshi et al, 2016). The *Without Thought Design*'s reliance on objective descriptions depends on symbolic conventions, serving both as the language of design and the purpose of its transmission. Therefore, the essence of *objective sketching* is the symbolic perception and transmission of those objectively existing a priori features in the cognitive process and does not rely on the traditional definition of sketching (i.e. pen on paper).

Found object involves the interpretative description of the perception of something external to the product, towards the internal symbolic system of the product, essentially product rhetoric. The rhetoric in *Without Thought Design* differs from ordinary product design rhetoric; it

emphasizes the harmonious unity of the quality characteristics of the '*vehicle*' and *'tenor*' within a product design system built on the foundation of users' collective unconscious conventions. Zhang (2022) identified a category of Without Thought Design that spans both 'objective sketching' and 'found objects' through extensive case analysis, naming it 'the Dual Crossover.' The following sections will explain the three types of *Without Thought Design* through case studies.

2.4.3.1 Objective Sketching

Objective sketching is the designer's description of users' behaviors and mental states within the original system of the product. Such descriptions do not include the designer's subjective interpretations; instead, they focus on the objective existence of users' consciousness and experiences within the cognitive processes related to the product system. Designers refine these a priori contents into signs within the product system and transfer this consciousness through the design text.

Objective sketching in *Without Thought Design* enables precise transmission of the meaning within the design text. Based on the types of unconscious behavior in product interaction, the content described by objective sketching includes users' direct consciousness and the experiential archetypes of collective unconscious. Direct consciousness is derived from the user's biological attributes, possessing innate, universally hereditary characteristics. When direct consciousness is analyzed and judged experientially, becoming a product sign carrying consciousness, it inevitably possesses a universal characteristic that any individual among users can accurately interpret the sign's meaning in a given environment. For example, Naoto Fukasawa (2016) observed that on rainy days, when people go shopping and enter buildings or subways, they unconsciously hang plastic shopping bags on the handles of their umbrellas. Thus,

he designed an umbrella handle with a groove for hanging items, making it convenient for shopping bags to be hung in the groove (Figure 2.22).

Figure 2.22 umbrella designed by Naoto Fukasawa (Zhang, 2022)

In this example, the designer first objectively described a pre-existing, universal behavior triggered by direct consciousness: 'On rainy days, when entering indoor environments, people unconsciously hang bags on umbrella handles.' Then, based on existing experience, the designer modified this (making the umbrella handle, which was originally not suitable for hanging objects, suitable for hanging objects) and formed a sign within the product system (the groove on the umbrella handle). Users who share the same direct unconsciousness can accurately interpret the meaning conveyed by this sign.

As Wilkinson (2009) stated, 'sketching' is an art; it is not a one-to-one 'replica' of the objective object but carries subjectivity. Although objective sketching in *Without Thought Design* is a portrayal of direct consciousness and collective unconscious archetypes, it still bears traces of the designer's subjective involvement. 'Objective sketching' is a selection and judgment made on the basis of the objective existence, with purposeful and valuable subjective modifications.

2.4.3.2 Found Objects

The *Without Thought Design* of finding associations emphasizes the interpretative connection between a cultural symbol external to the product and relevant symbols within the product text, also known as product rhetoric. Naoto Fukasawa believes that 'found object' does not involve directly applying a certain shape to a product, but rather involves creating a design theme based on the association between a product and something that is visualized, whether it be an object, a behavioral phenomenon, or a part of it (Takeshi et al., 2016). According to Peirce's semiotics, a symbol consists of three parts: 'object,' 'signified,' and 'interpretant.' Therefore, in rhetoric, the consciousness of the vehicle exists in an abstract form, and its abstract nature cannot directly explain the quality of the *tenor*. It must rely on the 'object' and 'signified' that can be touched by the human senses, forming a referential relationship between the vehicle's 'object' and 'signified.' On this basis, the consciousness that explains the quality of the *tenor* is obtained. The quality of the interpreted *tenor* must be attached to the *tenor*'s object to manifest its existence, forming a referential relationship between the *tenor*'s 'object' and 'signified.' Therefore, the essence of the rhetorical interpretation of the vehicle for the *tenor* is the consciousness formed by the referential relationship of the vehicle, which interprets the 'signified' in the *tenor*'s referential relationship (Figure 2.23).

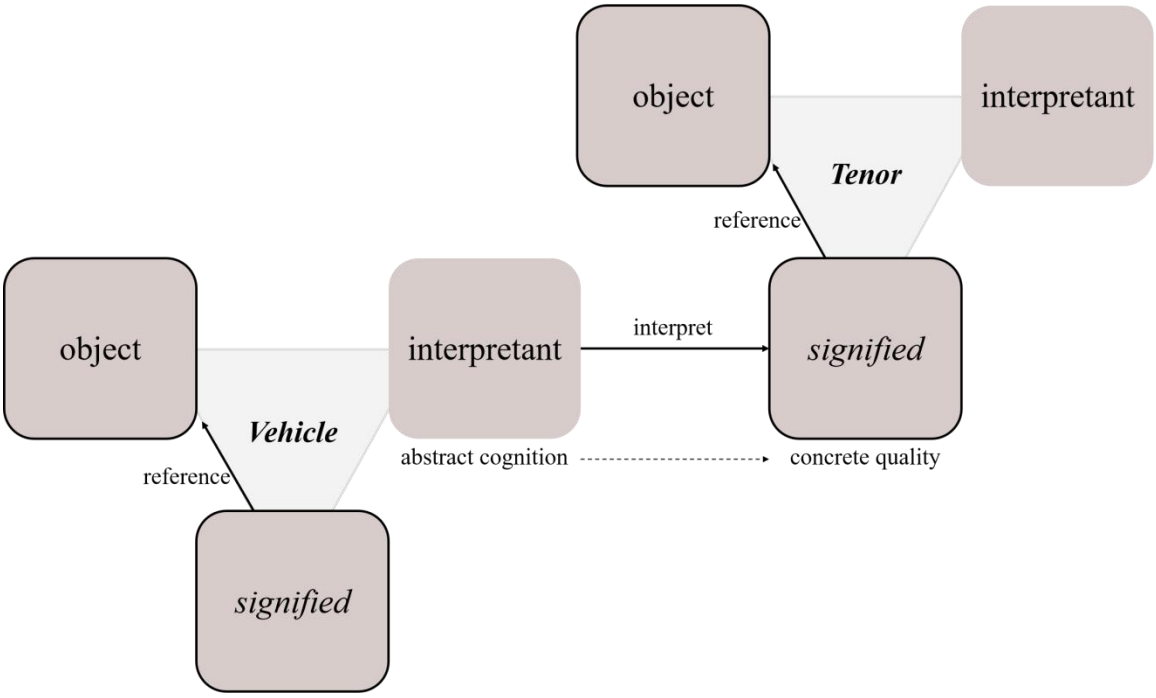


Figure 2.23 Intersymbolic rhetoric

According to Peirce's semiotics and general rhetoric, the common rhetorical devices used in product design include simile, implied metaphor, metonymy, synecdoche, and irony. Zhang (2022) posits that the rhetorical devices commonly used in the *Without Thought Design* of finding associations are simile, implied metaphor, and metonymy. Synecdoche and irony are not discussed within the realm of *Without Thought Design* focused on finding associations.

First, based on Naoto Fukasawa's definition of 'found object,' the *Without Thought Design* of finding associations specifically refers to the rhetorical interpretation between a cultural sign external to the product and the product's internal signs. Synecdoche, being a rhetorical device that uses a part of the product to refer to its entirety, and since both the '*vehicle*' and '*tenor*' originate within the product system, does not fall within the discussion of rhetorical methods for 'found object.'

Second, irony, compared to other rhetorical devices, is unique. While other rhetorical devices aim to maintain the original product system conventions after introducing a new sign into the product design system, irony seeks to negate the original product through the introduction of an external sign. Considering the purpose of *Without Thought Design* is to optimize product interaction experiences, irony is not within the scope of discussion.

Metonymy：

Metonymy is an important component of human thought and communication in daily life, as it is a way we think and talk about everyday events. Radden and Kövecses (1999) believe that metonymy is a process in which the conceptual entity of the vehicle provides a cognitive psychological channel for the conceptual entity of the *tenor*, within an idealized cognitive model based on consciousness and experience. This process is formed through direct contact, according to the principle of contiguity, and the main task of *metonymy* is the substitution of the referents of proximate *vehicles* and *tenors*. Panther and Thornburg (1999) classify metonymy into three types based on the content of the transformation between *vehicles* and *tenors*: 'referential metonymy', which involves the substitution of concepts; 'predicational metonymy', which involves the substitution of expressions; and 'speech act metonymy', which involves the substitution of speech acts. Zhao (2016) suggests that metonymy is extensively used in non-verbal signs. Most metonymies in product design are referential, meaning that two products of the same category but different types substitute for each other based on proximity. The proximate attributes that can be substituted include product type, function, operation, experience, and form texture. After metonymy, the original *vehicle* and *tenor* merge, parts of their original symbolic structures are hidden, and users perceive the original signs of the *vehicle* and *tenor* as a whole through Gestalt psychology (Figure 2.24).

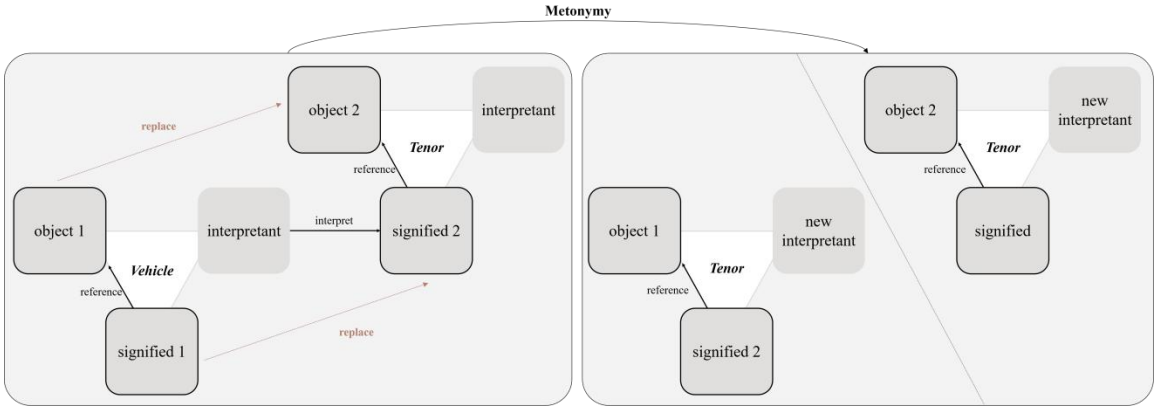


Figure 2.24 The rhetorical structure of metonymy

Rhetoric suggests that for metonymy to be effective, there must be a significant difference in salience between the *vehicle* and the *tenor*. Salience is a concept from perceptual psychology, occurring in the identification and comparison between objects. Objects with higher salience attract more attention, are easier to recognize, are processed preferentially in cognition, and can activate objects with lower salience (Günther et al., 2017), which is a general principle of metonymy.

Figure 2.25 demonstrates a product that shows the activation of a low-salience sponge brush by a high-salience soap dish. The soap dish and the sponge brush are proximate yet different types of products. The former, as a container that is normally placed, has higher salience than the latter, which is an occasionally used cleaning tool. The sponge brush can serve as the vehicle to metaphorically represent the soap dish, the *tenor*. The object of the sponge can substitute for the overall symbolic object of the soap dish, with the 'container' as the signified of the soap dish's overall sign being preserved. To ensure that the low-salience 'sponge brush' can be activated by the high-salience 'soap dish,' the designer, when constructing the referential relationship between their symbolic structures, leans towards the 'soap dish' (making the sponge brush in the shape of a soap dish). Only in this way can users quickly determine, through collective unconscious

archetype experiences, that this is a sponge soap dish, rather than a sponge brush that can hold soap.

Figure 2.25 Sponge soap box (Zhang, 2022)

Simile：

Simile relies on the physical resemblance between the '*vehicle*' and the '*tenor*.' In the *Without Thought Design* of finding associations, the fidelity of the external signs to the internal signs of the product system is maximized. In terms of the rhetorical structure between signs, the construction of a simile rhetorical structure can be based on either the morphological similarity between the 'object-object' of the *vehicle* and the *tenor* or the quality similarity between the 'signified-signified' (Figure 2.26).

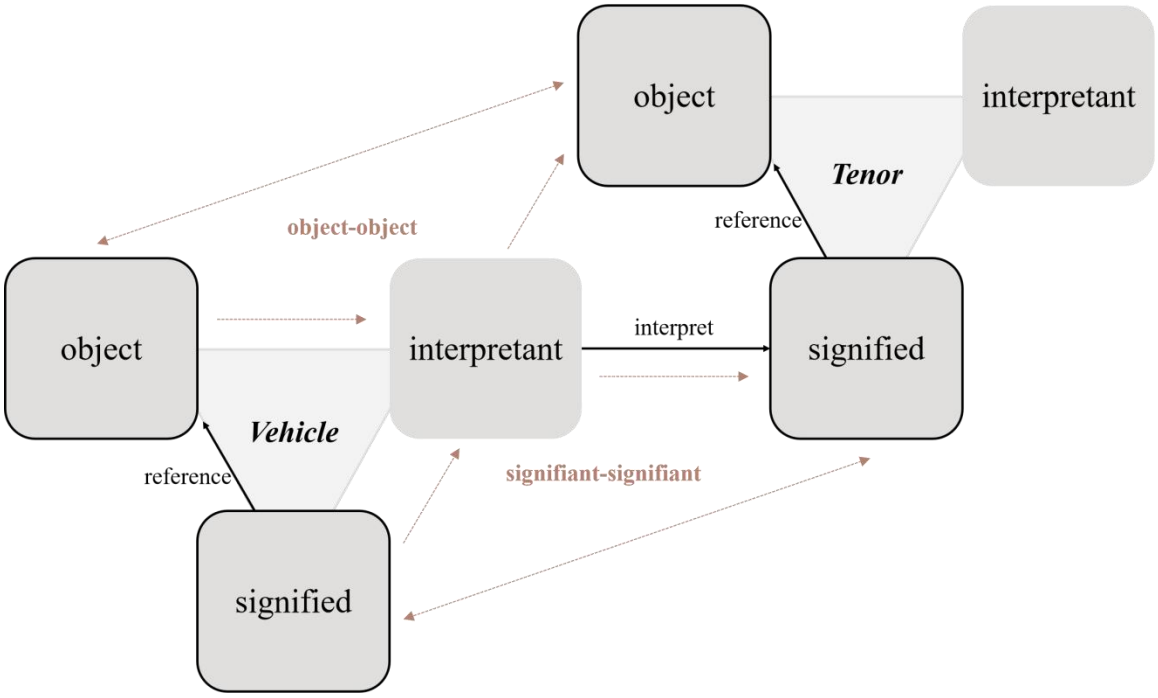


Figure 2.26 The rhetorical structure of simile

Figure 2.27 shows two examples of simile product rhetoric. DaiSato's porthole watch uses an 'object-object' rhetorical structure, likening the watch face to an airplane porthole by simile based on their similar shapes. Meanwhile, the stabilization technologies on cameras use a 'signified-signified' rhetorical structure, comparing the stability of the camera to the stability of a chicken's head based on their similar qualities, thus forming a simile rhetoric for the product.

Figure 2.27 Similes in product rhetoric

Implied metaphor：

The essential characteristic of implied metaphor is the association based on similarity between the *vehicle* sign and the *tenor* product text, leading to a rational interpretation of meaning. Implied metaphor can not only identify but also fuse the *vehicle* and *tenor*. I. A. Richards believes that the essence of implied metaphor is interaction, where two words from different contexts interact semantically, ultimately producing a new meaning. Thus, similarity is the basis for implied metaphor to connect two things. In the context of product rhetoric, cross-domain similarity is a prerequisite for implied metaphor. Unlike the physical similarity between two things in simile, the psychological similarity between two things across domains is the main source of implied metaphor. Combined with Peirce's decomposition of the symbolic structure, product implied metaphor has three semiotic rhetorical structures (Figure 2.28):

1. The designer creatively interprets the form of the object in the vehicle sign, establishing a psychological similarity between the thing and the product.

2. The designer creatively interprets the quality of the signified in the vehicle sign, establishing a psychological similarity between the thing and the product.

3. The designer creatively interprets the referential relationship between 'object-signified' in the vehicle sign, forming a creative symbolic signification relationship and establishing psychological similarity between the thing and the product.

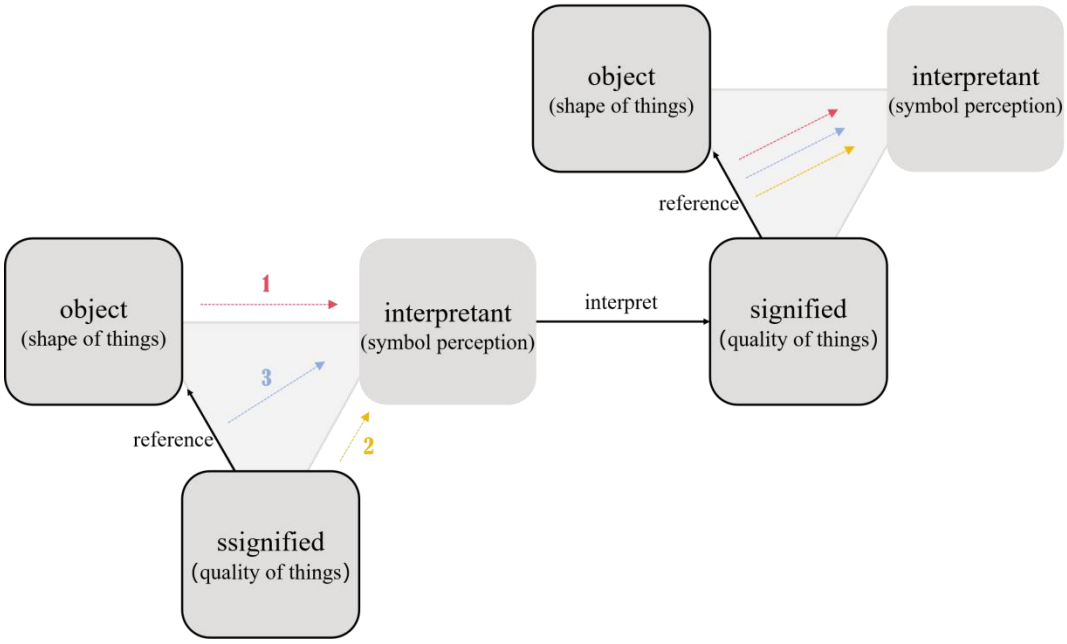


Figure 2.28 The rhetorical structure of implied metaphor

Figure 2.29 illustrates DaiSato's design of the 'Pig Nose Piggy Bank,' which implied-metaphorically uses the pig nose as a vehicle to represent the piggy bank. Firstly, the designer creatively interprets the referential relationship between 'object-signified' in the vehicle sign of the pig nose as 'the hollow form of the pig nose allows for putting things inside.' Then, it is associated with 'a piggy bank can hold coins,' establishing a psychological similarity between the pig nose and the piggy bank. The designer's choice of the pig's 'nose' as the vehicle is influenced by users' collective unconscious archetype experiences. The pig and the piggy bank have formed a fixed association in users' accumulated life experiences. Therefore, such a metaphorical approach to product design can also be understood and accepted by users.

Figure 2.29 Pig Nose Piggy Bank (Chan, 2010)

2.4.3.3 The Dual Crossover

Based on the two types of *Without Thought Design* proposed by Naoto Fukasawa, 'objective sketching' and 'found objects,' Zhang (2022, p266) analyzed a large number of *Without Thought Design* works and found that there is a third type that runs through the two basic types of *Without Thought Design*, and named it 'The Dual Crossover.' The concrete ways of crossing are 'objective sketch of direct consciousness - life experience - symbolic rhetoric' and 'symbolic rhetoric - life experience - direct consciousness,' respectively.

Zhang explained the first type of 'Crossover' as seeking a rational explanation of symbolic meaning from users' biological attributes to their social and cultural attributes. He explained the second kind of 'Crossover' as starting from social and cultural signs and product rhetoric, exploring how to de-symbolize the rhetorical product language in the product system environment to obtain a direct consciousness of users' biological attributes. For example, Figure

2.30 shows the 'Quolo incense holder' designed by Tomomei Murata. The designer first associated the geometric form of a cube and cylinder with the container of the incense burner and carried out rhetorical interpretation. User's 'inserting incense' and 'collecting incense ash' when using an incense burner are both unconscious behaviors caused by the direct consciousness of 'things that can be stored in the depression.' Therefore, after 'found objects,' the designer revised the language of the product itself and set a concave pyramid and concave hemisphere at the top of the cube and cylinder, respectively. As a de-symbolized design language, 'concave' not only clearly indicates the way to insert incense but also can collect incense ash.

Figure 2.30 Quolo incense holder (Zhang, 2022)

In the *Without Thought Design* types of 'the Dual Crossover' proposed by Zhang, the essence is the sequential application of the two fundamental types, 'objective sketching' and 'found objects,' in the same product. Consequently, it is evident that in practical product design, two types of *Without Thought Design* methods can be incorporated simultaneously, depending on the specific design objectives.

2.5 Conclusion

Chapter 2 provides a literature review on users' unconscious behavior, product interaction design, and the intersection between these two domains. Firstly, the chapter explains the source

of unconscious behavior. Based on existing research in psychoanalysis and ecological psychology, users' unconscious behaviors have three sources: direct consciousness, indirect consciousness, and collective unconsciousness, with the scope of collective unconsciousness including the unconscious and subconscious in public cognition.

Secondly, in the context of product interaction design, discussing unconscious behaviors from the perspectives of direct consciousness and collective unconsciousness is more feasible and universal. This is a narrowing made by reviewing the literature on product interaction design and combining the three sources of users' unconscious behavior. Therefore, this chapter explains the application of users' unconscious behaviors in product interaction design from the perspectives of direct consciousness and collective unconsciousness by using cases examples.

Thirdly, this chapter introduces *Without Thought Design* as a existing design category covering users' unconscious behaviors. The literature review on *Without Thought Design* includes definition of *Without Thought Design* and its disciplinary foundations. Among these, product semantics and product syntax offer research paths for the construction of *Without Thought Design* methods. Product semantics analyzes the relationship between design symbol text and symbol meaning in product design, as well as the rationality issues of design rhetoric. Peirce's general rhetorical theory further classifies and explains rhetorical figures. Building on product semantics, product syntax structurally analyzes the expression of symbol meaning and various rhetorical methods. The decompositions of symbol structure by Saussure and Peirce are of significant importance, providing illustrative tools for the study of product syntax.

Finally, this chapter discusses three types of *Without Thought Design*. Zhang uses semiotics to explain three rhetorical figures present in *Without Thought Design* with "found objects": simile, metonymy, and implied metaphor. These rhetorical figures summarize the relationship between

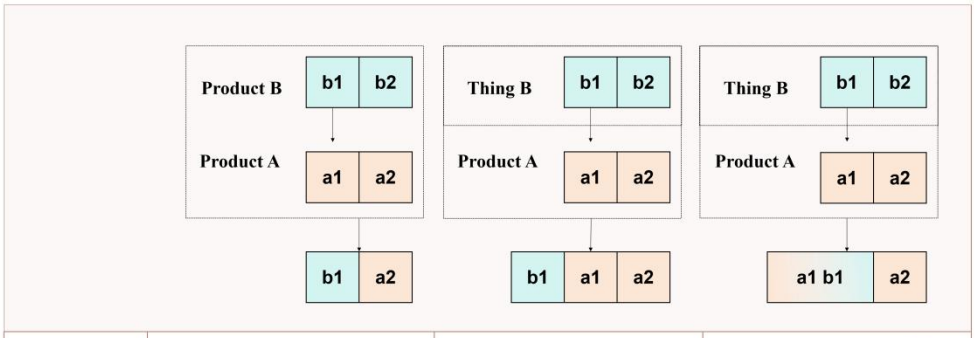
product A and the analogous product B. They can also be summarized as follows: **Metonymy** - a part of product B replaces product A; **Simile** - the overall concept of product B covers product A; **Implied metaphor** - the concept of product B integrates into product A, which is more abstract than simile and reflects the user's psychology.

This chapter presents theoretical study about related design methods. Further summary and consolidation will be needed before applying them to the design guideline.

Chapter 3: Design Guidelines

This chapter introduces the design guideline of applying user's unconscious behaviors into product design, forming alternative interaction in product iteration. The design process in this guideline builds upon design council's framework for innovation (Figure 2.2) and innovation design model (Figure 2.3) and focuses on the specific aspect of *Without Thought Design*. By utilizing this guideline in either of these two design processes, designers can reduce the cognitive burden on users as they learn and adapt to the product that been updated or iterated. Designers need to know that this guideline can only be used as guide and reference. When using the guideline for practical operation, designers need to think and make judgement with their own experience. This guideline only studies how to apply user's unconscious behavior to product interaction innovation, and there is no guarantee that this guideline can be applied to all product industry.

The design method which will be adapted into this guideline is *Without Thought Design*, proposed by Japanese designer Naoto Fukasawa, and further developed by Jian Zhang. This design method is based on Universal Rhetoric in Peirce's Semiotics, converting the product into signs and text, using rhetoric models as the basic logical framework to interpret the product text produced through *Without Thought Design*. The following form summarizes the characteristics of these rhetorical figures, their brief usage process, and their purposes (Figure 3.1).



Rhetoric Method	**Metonymy**	**Simile**	**Implied metaphor**
Range of Application	Between different products in one categorie	Between things and products	
Manifestation	**Partial** replacement	**Physical** similarity	**Psychological** similarity
Essence	**Replacement** of features with the same attributes in two products	**Add** similar form，similar feature	**Integration**，感知features
	Tangible External ⟷ Abstract Intrinsicl Partial ⟷ Entirety"		
Applicable elements	Substructure, components, functions, local interactions, etc.	External form, overall interaction.	Emotion, meaning, senses
Case	 The designer collects the unconscious behaviors of Product A, replacing parts of Product A's unconscious behavior with the local interactions of Product B, innovating the local interaction methods while retaining user behavior.	 The designer subjectively imbues Product A with the form and interaction of Product B, giving Product A a new form and interaction.	 The designer identifies the user's emotional needs and integrate the perceptual feature of Product B to Product A.

Figure 3.1 Summary of three rhetoric type in *Without Thought Design*

Based on the first type of *Without Thought Design*: “objective sketching”, it can be concluded that designing for users' unconscious behavior has two angles: First, designer studies the existing unconscious behaviors associated with the product. Second, designer subjectively assigns new unconscious behaviors. The second angle is a design phenomenon summarized by scholars through case studies of *Without Thought Design*. This angle uses simile as a rhetoric method. It

has not yet developed into a scientific and systematic design method. Instead, it relies more on the designer's personal life experience and design expertise. Therefore, this study will not delve into it. This study focuses on the unconscious behaviors of users when interacting with the target product. In conclusion, the application of unconscious behaviors by users will be explored through the following three design routes.

- Designers add product features and affordance based on users' unconscious needs.
- Designers innovate interactions by identifying product B for partial interaction replacement based on users' unconscious behaviors.
- Designers assign corresponding perceptual features to product A based on users' emotional needs, providing emotional value or evoking emotional resonance.

This section, based on the theoretical model, refines three practical design routes by which designers utilize users' unconscious behaviors to innovate interactions. It integrates into existing design theories and design processes, culminating in the final design delivery. First of all, an overview of guideline (Figure 3.2) is presented, including three design routes this thesis developed, followed by tools that designers can apply in each step. In this figure, *objective sketching* and *found object* are two directions of *Without Thought Design* (see 2.4.3.1 and 2.4.3.2 for definition).

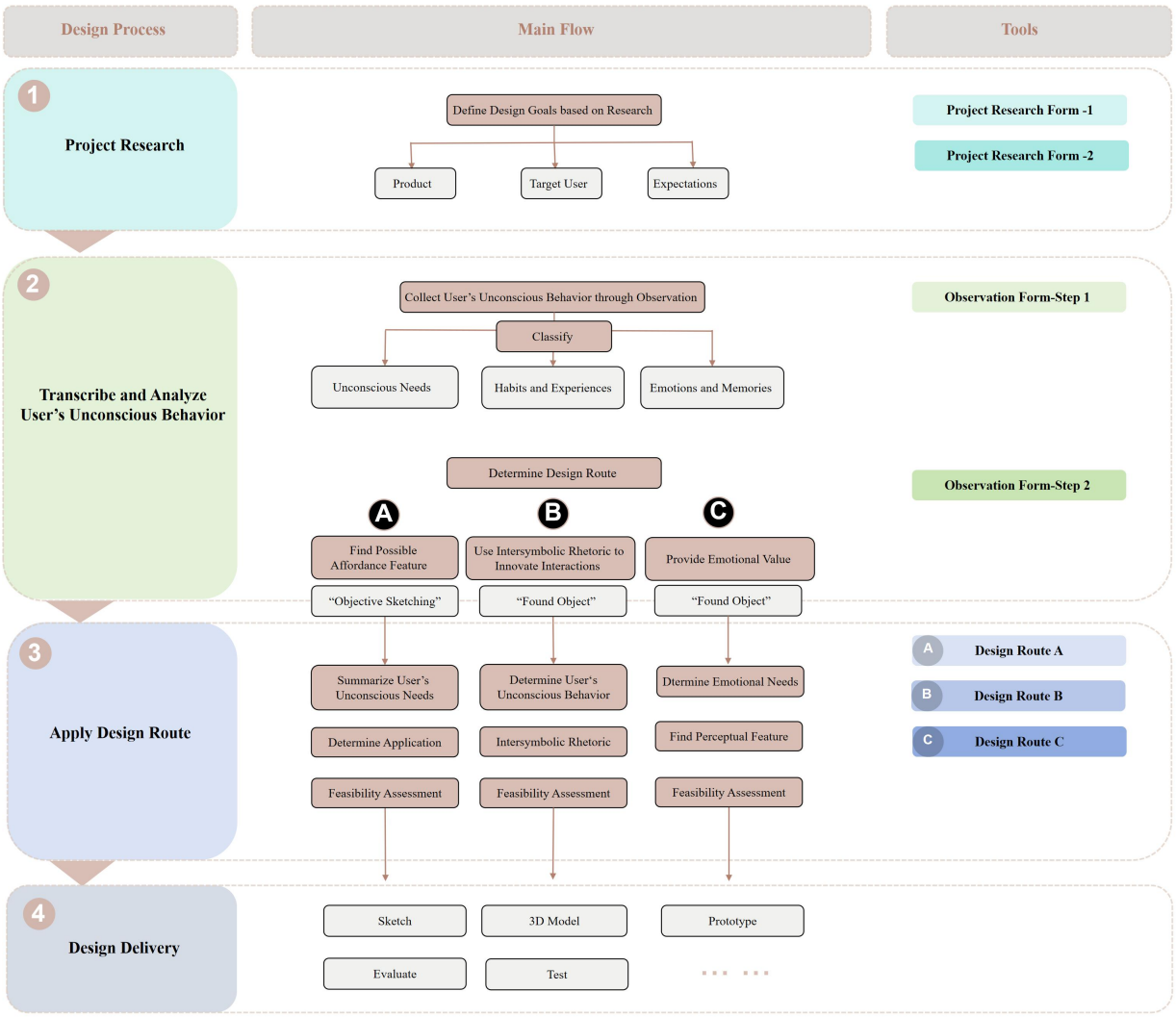


Figure 3.2 Overview of Guideline

When incorporating users' unconscious behavior into product design, it's necessary to select different design methods for various design objectives, though the design process remains fundamentally similar. The concept of *Without Thought Design* reveals that before designing a product, we first need to observe and collect people's unconscious actions, and then incorporate these actions into the product design. Therefore, the process of *Without Thought Design* can roughly be divided into a design process that includes four phases: 1) Project Research, 2) Transcribe and Analyze User's Unconscious Behavior, 3) Apply Design Route (3 options), and 4) Design Delivery.

- Project Research
  - Step 1 Product Research
    - 01 Background
    - 02 Competitor Analysis
  - Step 2 Target User Research
    - 01 Persona
    - 02 Interaction Journey
    - 03 User Interview
  - Step 3 Design Exploration
    - 01 Cross-Axis or Spider Chart
    - 02 Research Summary
- Transcribe and Analyze User's Unconscious Behavior
  - Step 1 Collect Unconscious Behavior
  - Step 2 Determine Design Route
- Apply Design Route (3 options)
  - Design Route A – Find possible affordance
    - Step 1 Summarize user's unconscious needs – functional and usability
    - Step 2 Determination
    - Step 3 Feasibility Assessment
  - Design Route B – Use intersymbolic rhetoric to innovate interactions
    - Step 1 Determine user's unconscious behavior
    - Step 2 Intersymbolic Rhetoric – Metonomy
    - Step 3 Feasibility Assessment

- Design Route C – Provide Emotional Value
  - Step 1 Define Users' Emotional Needs
  - Step 2 Find Perceptual Features
  - Step 3 Feasibility Assessment

■ Design Delivery

Before starting, designers should note that products involving user safety, health, and personal information security, as well as those subject to government regulation and legal requirements, are not suitable for this guideline. These products must undergo systematic design and testing to ensure their safety, reliability, and compliance. Designers should avoid applying this guideline to products that meet the above conditions.

■ Products requiring precise learning and training before use. For example; complex electronics, special vehicles.

■ Products that need to strictly follow the specified use procedures. For example: medical devices, chemicals and dangerous goods.

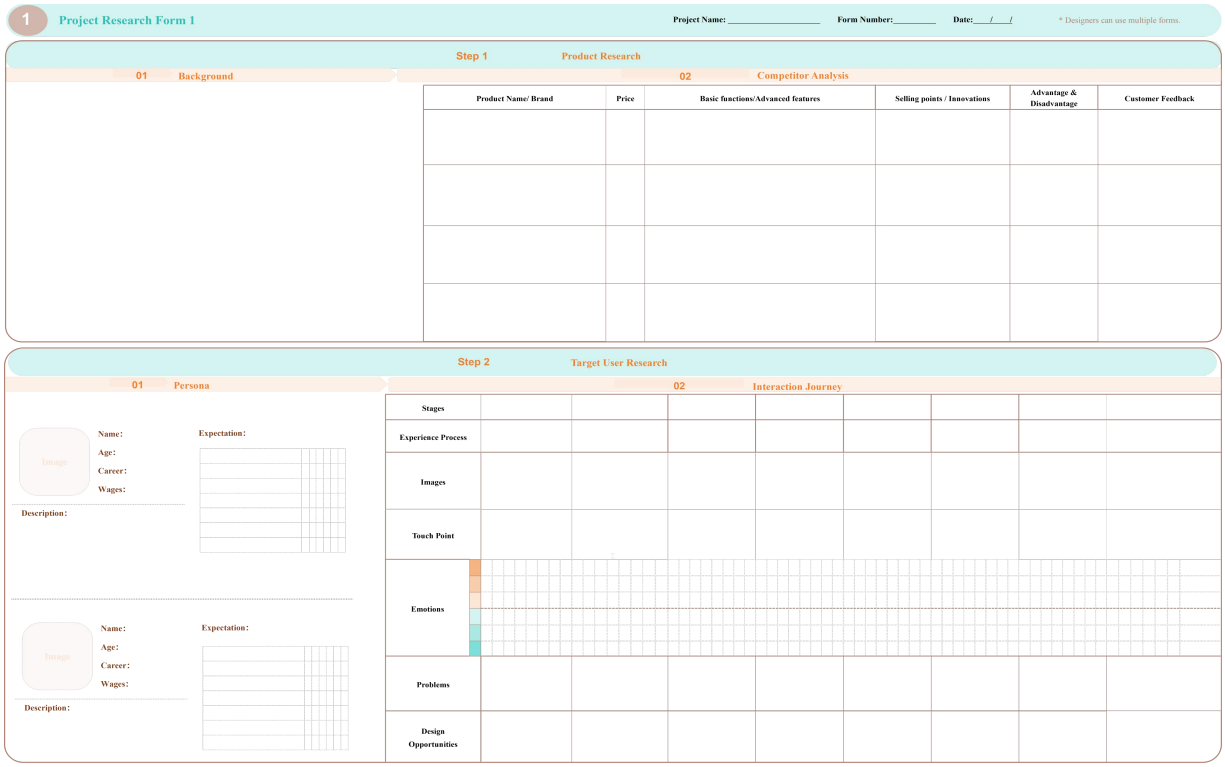
3.1 Phase 1 - Project Research

Before conceptualizing a design, designers need to define the design goals and conduct relevant research. The concept of Affordance emphasizes the study of the relationship between people, objects and the environment. This part of the research is based on the target product, target users and different usage scenarios, not only to identify the existing problems, but also to summarize the user's expectations and needs for the target product for future reference.

The focus of this study is to observe and apply users' unconscious behaviors. However, before collecting and analyzing these unconscious behaviors, designers also need to conduct research on the target users. Donald Norman in his book *The Art of Design* emphasizes the importance of

user-centered design (Norman, 2013). Alan Cooper et al. (2014) in *About Face* describe the basic principles and methods of interaction design that emphasizes the importance of user research and analysis. The purpose of applying users' unconscious behavior to a product is to provide different interaction patterns for the product. Therefore, during the pre-study phase, the designers can employ two Project Research Forms (Figure 3.3) to collect related information.

All forms shown in this document are designed to be printed on tabloid (17”x11”)paper and are available full size in the Appendices.



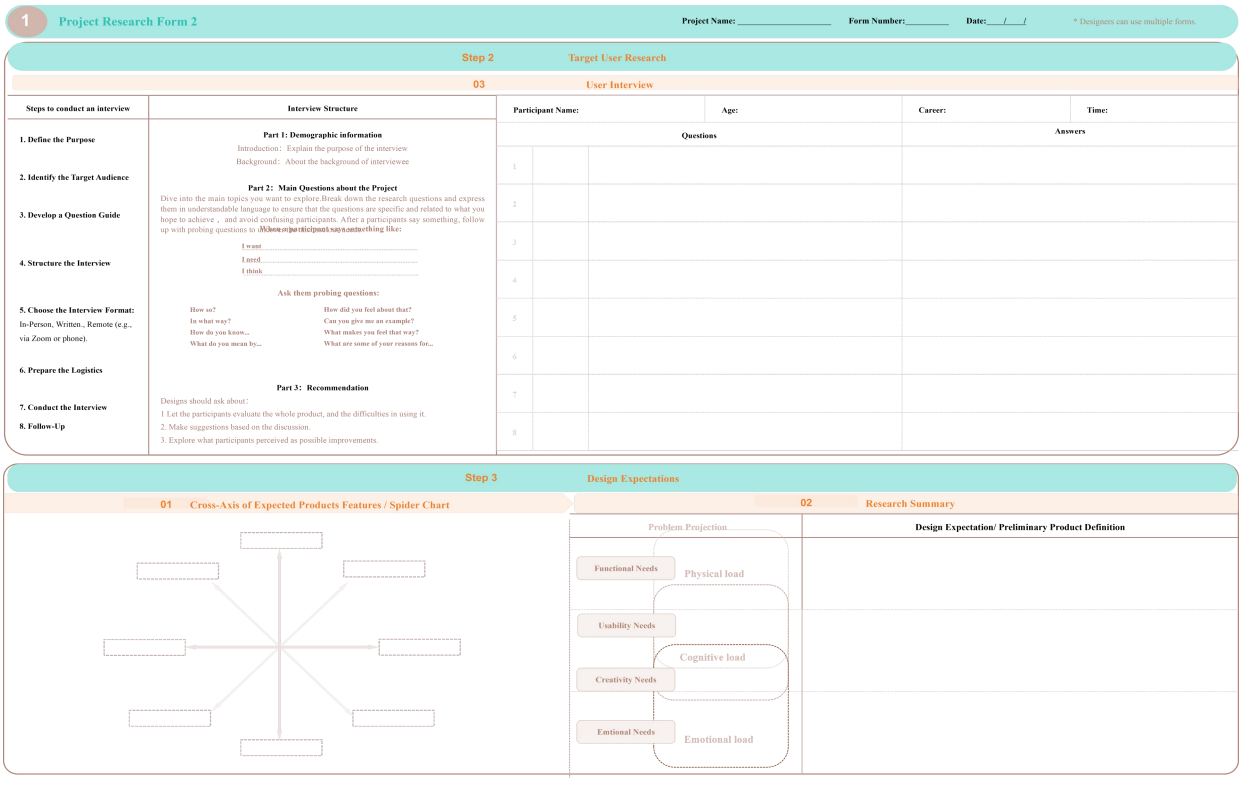


Figure 3.3 Project Research Forms

3.1.1 Step 1 Product Research

01 Clarify Research Objectives（Background）:

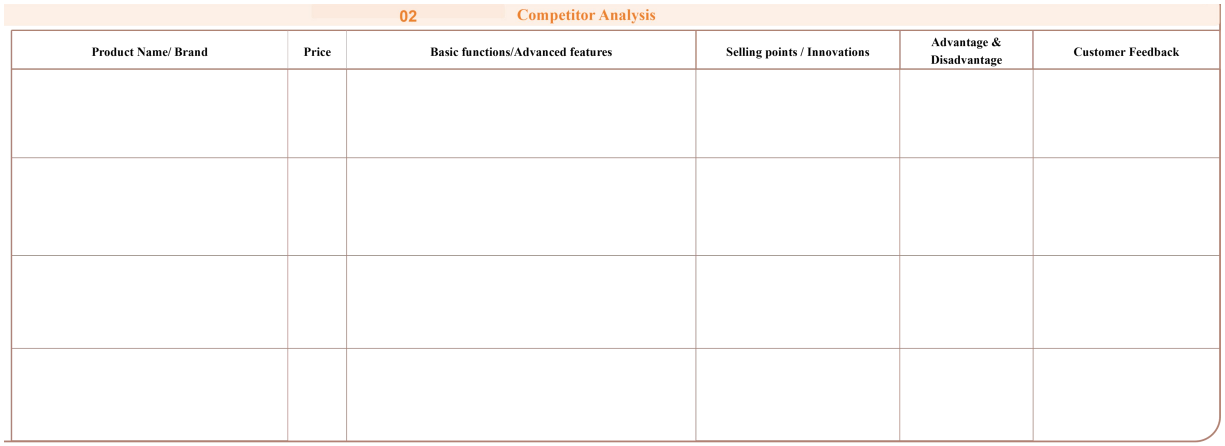
In this step, designers should determine the target product and start research. First, they need to recognize the background of the project and fill it in Project Research Form 1 - Step 1- Background (Figure 3.4). Designers can visualize the information through data charts, tables, etc. The content filled in this part can be market performance analysis, including sales data, market share and growth trends (Mironov, 2008) or known problem statements, etc. This step is designed to give the designer an initial understanding of current market trends and competition through background research. This helps the designer to stay competitive by incorporating the latest design trends in the design process (Martin et al., 2012). It also identifies market gaps to inform product positioning.

Figure 3.4 Background

02. Analyze competitors' products and gather user feedback:

By following this step, designers will have insights into the market dynamics and customer preferences (Cooper, 2011), which helps in identifying usability problems and opportunities for

improvement (Norman, 2013). Designers need to fill out the section of Project Research Form 1 - Step 1- Competitor Analysis in the table according to the following information (Figure 3.5).



02 Competitor Analysis

Product Name/ Brand	Price	Basic functions/Advanced features	Selling points / Innovations	Advantage & Disadvantage	Customer Feedback

Figure 3.5 Competitor Analysis

- The framework of competitive product analysis can refer to SWOT analysis (Humphrey, 2005). Designers should meticulously itemize all functionalities and features of their product as well as those of competitor products or similar types of products. This includes basic functions, advanced features, usability characteristics, technical specifications, and the Unique Selling Points (USP) and innovations of each product (Tyson, 2005). Designers should summarize the advantages and disadvantages of existing products (Lockwood, 2010).
- Designers should gather user feedback and public opinion through social media, forums, review sites, etc. (Mironov, 2008). This step allows companies to understand public opinion and customer experiences. This information can help identify common issues, popular features, and areas needing improvement.
- Review Sites: Analyzing reviews from platforms like Amazon, Yelp, and others can provide valuable insights into customer satisfaction and product performance. This feedback helps in refining products and services to better meet customer needs.

Designers can use following online tools and platforms to collect market data and user feedback:

Online Tools and Platforms: Utilize tools like Google Analytics and App Annie to gather market data and analyze user behavior.

Online Resources: Gartner and Forrester are analytical and research organizations that offer in-depth reports on various technologies and products, which can help in comparing functionalities and features. Product Hunt and Capterra are websites that provide evaluations and comments on various products from users and industry experts, offering tangible feedback on product functions, user experience, and innovations.

3.1.2 Step 2 Research on Target User

Designers first need to identify target users. The purpose of researching target users is to obtain genuine feedback from the target group and to collect information on the interaction points of existing products in combination with usage scenarios. This will provide references for designers when choosing a design direction in the second part. Research on target users can utilize the following methods:

01 User Persona：

Designers should fill in Project Research Form 1 - Step 2 - 01 Persona (Figure 3.6). This step is to determine the target user groups for the study, including their characteristics, needs, and behavioral patterns. By creating multiple user personas, the design team can better understand the characteristics, needs, and behavior patterns of the target users. This helps in designing products that more closely meet user expectations (Cooper et al., 2014). From this step, designers can narrow down the scope of *direct perception* and *collective unconscious* in the second part of the research by identifying the target users of the product.

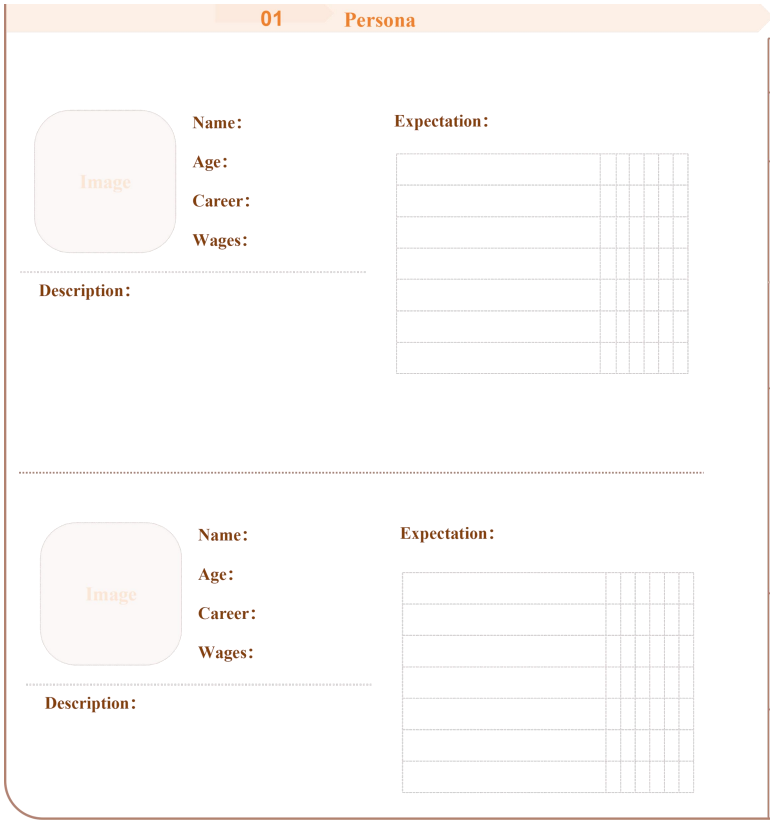


Figure 3.6 Persona

02 Interaction Journey:

Designers should fill in Project Research Form 1- Step2 - 02 Interaction Journey (Figure 3.7). Contents in this form can be adjusted according to the project. The second method of applying unconscious user behavior to product design is Finding Object, which involves two directions: triggering user interactive behaviors and emotions through product characteristics. At this point, using the Interaction Journey can reveal key touch points in user interaction behaviors and emotional responses, as well as user preferences (Benford et al., 2009). It is also necessary to consider the factors of different use cases. These key touchpoints can serve as a starting point for users to improve their existing interactions. In the end, designers should analyze the user journey map to identify key touchpoints and loads in the user's interactions with the product or service,

identifying potential areas for improvement (Cooper et al., 2014). This information can be used as the basis for designers to decide the design direction.

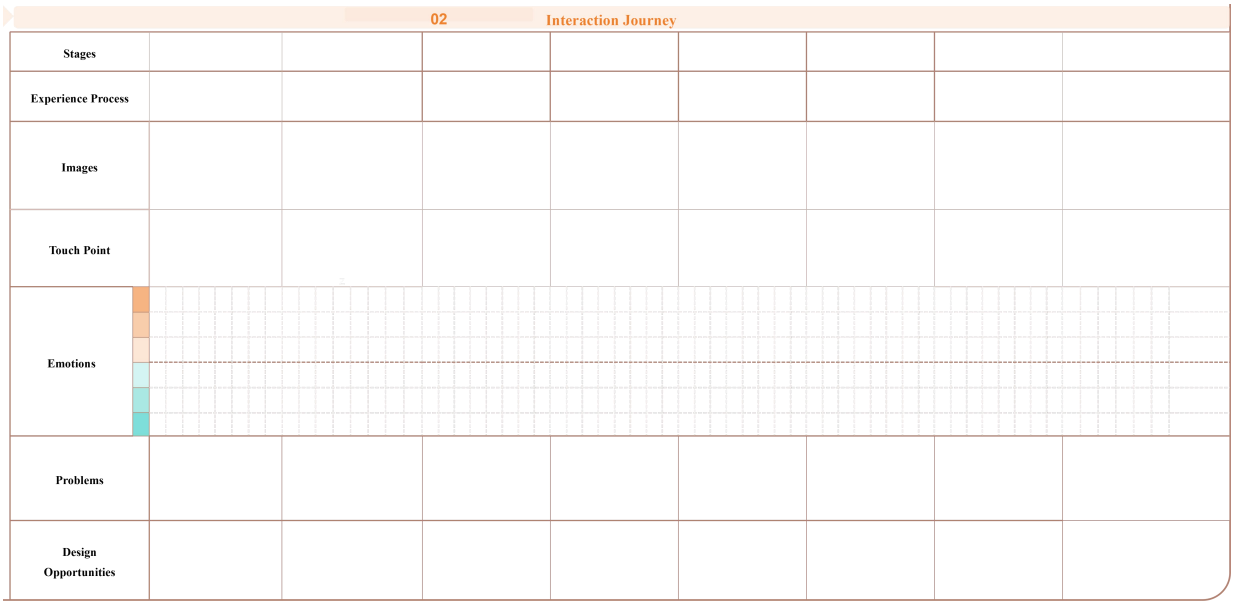


Figure 3.7 Interaction Journey

03 User Interviews:

Through multiple one-on-one interviews, designers can gain a deeper understanding of the user's personal experiences, feelings, and motivations. The interview can be structured, semi-structured or unstructured in order to elicit the user's emotions and experiences more naturally. Designers need to refer to Conduct an Interview's approach and three structures on the left side of the figure (Figure 3.8) to design questions uncovering the user's unconscious needs (Delve & Limpaecher, 2019). It is also necessary to guide users to state explicit needs in other questions. Designers need to design their own questions based on the project and record them in the Project Research Form 2- Step2 - 03 User Interview (Figure 3.8). The reason for not using other research methods, such as filling out questionnaires and ticklists, is that during the interview process, asking questions can often be the first time to trigger the participants' direct reflections, which is the truest fact, and thus avoids the cognitive bias generated by overthinking in many other forms.

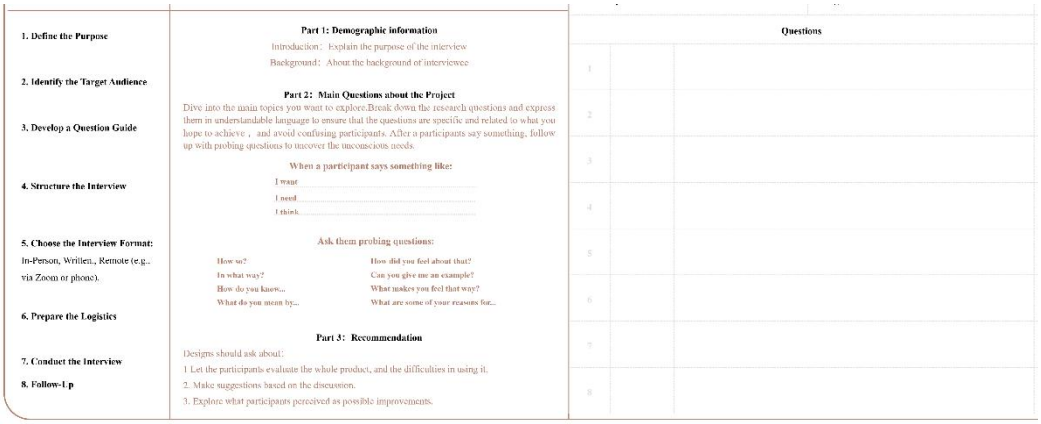


Figure 3.8 User Interview

Conduct an Interview can refer to the following specific content:

1. Define the Purpose. Clearly outline the objective of the interview. For example, gather qualitative data for research, evaluate a product, or gain customer insights, etc. (Kvale & Brinkmann, 2009)
2. Identify the Target Audience

   Identifying your interviewee-users of the product (Rubin & Rubin, 2011) can refer to the consumer groups in the first step of market research and the information in the user profile in the second step.
3. Develop a Question Guide

   Create a list of questions that align with your interview goals. Questions should be: Open-ended: Encourage detailed responses rather than simple yes/no answers. Clear and Concise: Avoid complex or ambiguous language. Probing: Include follow-up questions to dig deeper into responses (Knott et al., 2022).
4. Structure the Interview

   Organize the interview into three sections:

- Demographic information: Briefly explain the purpose of the interview, and record the background of your interviewee.
- Main Questions about the Project: Dive into the main topics you want to explore. Break down the research questions and express them in understandable language to ensure that the questions are specific and related to what you hope to achieve , and avoid confusing participants. After a participants say something, follow up with probing questions to uncover the unconscious needs (Delve & Limpaecher, 2019).
- Recommendation: Designs should let the participants evaluate the whole product, and the difficulties in using it, make suggestions based on the discussion, and finally explore what participants perceived as possible improvements.

5. Choose the Interview Format

   Formats include such as in-person, online interview (e.g. via Zoom or phone), etc., and conducted different ways to protect user privacy.

6. Prepare the Logistics

   Select a suitable interview location and determine how to record the entire process.

7. Conduct the Interview

   Before starting, the designer needs to build rapport with the interviewee; during the main questions, the designer needs to use active listening while taking notes (DeJonckheere & Vaughn, 2019). During the interview, designers should stay neutral, avoid leading questions or showing bias, and try not to interrupt the coherent responding from the interviewees (Gerson & Damaske, 2020).

8. Follow-Up

Integrate the interview, transcribe the information and analyze it.

As a basic user-centred design method, interviews not only allow designers to visualize users' needs, pain points (Jesse, 2011), but also allow designers to develop empathy with users (Martin et al., 2012). By conducting interviews, designers can test hypotheses, collect detailed qualitative data, and identify hidden needs that may not be apparent through other research methods (Portigal, 2023), providing data to support subsequent research on unconscious behavior.

3.1.3 Step 3 Design Expectations

In this step, designers need to synthesize their findings based on the previous research and fill out the following two parts.

01 Cross-Axis of Products Features/ Spider Chart (Figure 3.9):

First, identify the product character that fills in each quadrant, which can be the desired style intent, specific elements, functional features, etc. If the designer only wants to determine the general direction through this step, he or she can use the more abstract Cross-Axis. If the designer wants to form a more detailed plan for the product, he or she can use multiple orthogonal axes to refine the features and form a Spider Chart. Next, based on the data of similar products or analyzed competitors, the designer marks the corresponding degree on the quadrant, and finally defines his/her own expected design. Through this way, not only can we systematically locate potential areas for improvement and innovation, but we can also define a new design for the product (Cooper, 2011). The use of multiple orthogonal axes, coupled with the ability for designers to make subjective judgments and add their personal understanding, gives designers a tangible orientation to the intended design.

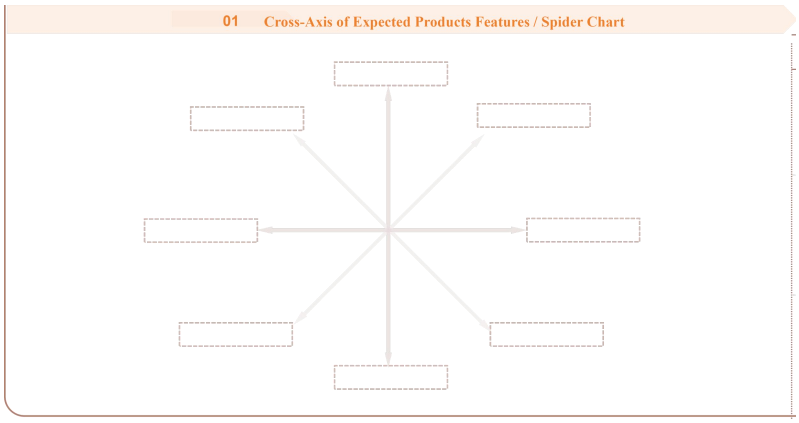


Figure 3.9 Cross-Axis of Products Features/ Spider Chart

02 Research Summary

The designer needs to summarize the previous research on the product and users. The designer should fill in the Design Expectations/ Preliminary Product Definition section (Figure 3.10). At the same time, with reference to the correlation between the left-tested user requirements and the existing load, the Design Expectations or Preliminary Product Definition should be briefly categorized, so as to provide an objective reference for the final application of the unconscious behaviors and the specific design solutions. Designers can mark all the related information in all of the previous research form, visualize that important information (Figure 3.10), in order to quickly find the corresponding source of information as a reference in the next few steps. This part corresponds to the three directions of unconscious application, allowing designers to clearly identify directions for improving product interaction, and user needs. In subsequent research, designers can refer to unconscious behaviors that strongly correlate with these issues to In subsequent research, designers can refer to the unconscious behaviors that are strongly related to these problems to innovate on interaction and improve the objective user physical load, cognitive load, and emotional load correspondences.

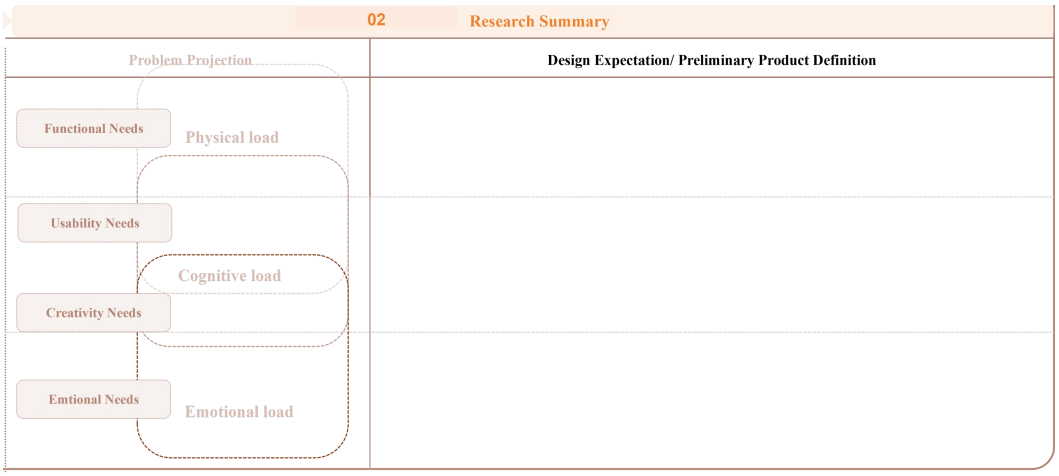


Figure 3.10 Design Expectations/ Preliminary Product Definition

3.2 Phase 2 - Transcribe and Analyze User's Unconscious Behavior

3.2.1 Step 1 Collect User's Unconscious Behavior

For the study of users' unconscious behavior, designers do not need to talk or interact directly with the user. What they need to do is to find out those triggers that can stimulate people's behavior and emotion and use them in the design of the target product object in order to achieve the purpose that people will use the product or feel some kind of emotion without overthinking or explanation. Therefore, people's unconscious behavior is a key element and an important source of inspiration for designers to get design ideas. In this step, designers need to collect multiple users' unconscious behaviors through observation methods and use record sheets to organize and categorize the unconscious behaviors to support the next step.

The method used to collect user behavior is observation. Observation is to attentive looking and systematic recording of people, artifacts, environments, events, behaviors, and interactions (Hanington & Martin, 2019). Observations can be structured, where data collection is organized around specific variables and a predefined schedule, or semi-structured, which is more open-ended and does not have predetermined variables or objectives (Tenny et al., 2023). In this guideline, Observation is structured, avoiding guidance from designers. Compared with other

methods, the observation method weakens the presence of the designer; the user needs to act spontaneously in this section and naturally complete the entire product use process.

Designers should do systematic observation, which is formalized by pre-structure utilizing worksheets to track time intervals, behavioral categories, or counted successes and errors (Hanington & Martin, 2019). In this step, the designer should not be involved in the product's use, interfere with the user's use, or appear to have guiding words. The only thing the designer needs to do as an observer is record every user action. For subsequent analysis and review, it is recommended that the designer use a device to record the complete process when making observations with notes, sketches, photographs, or video.

An Observation Record Form (Figure 3.11) along with instructions for its usage on the top have been created. Full size versions of these sheets are included in the Appendices. Designers can use multiple forms to record different usage scenarios and usage steps of the product.

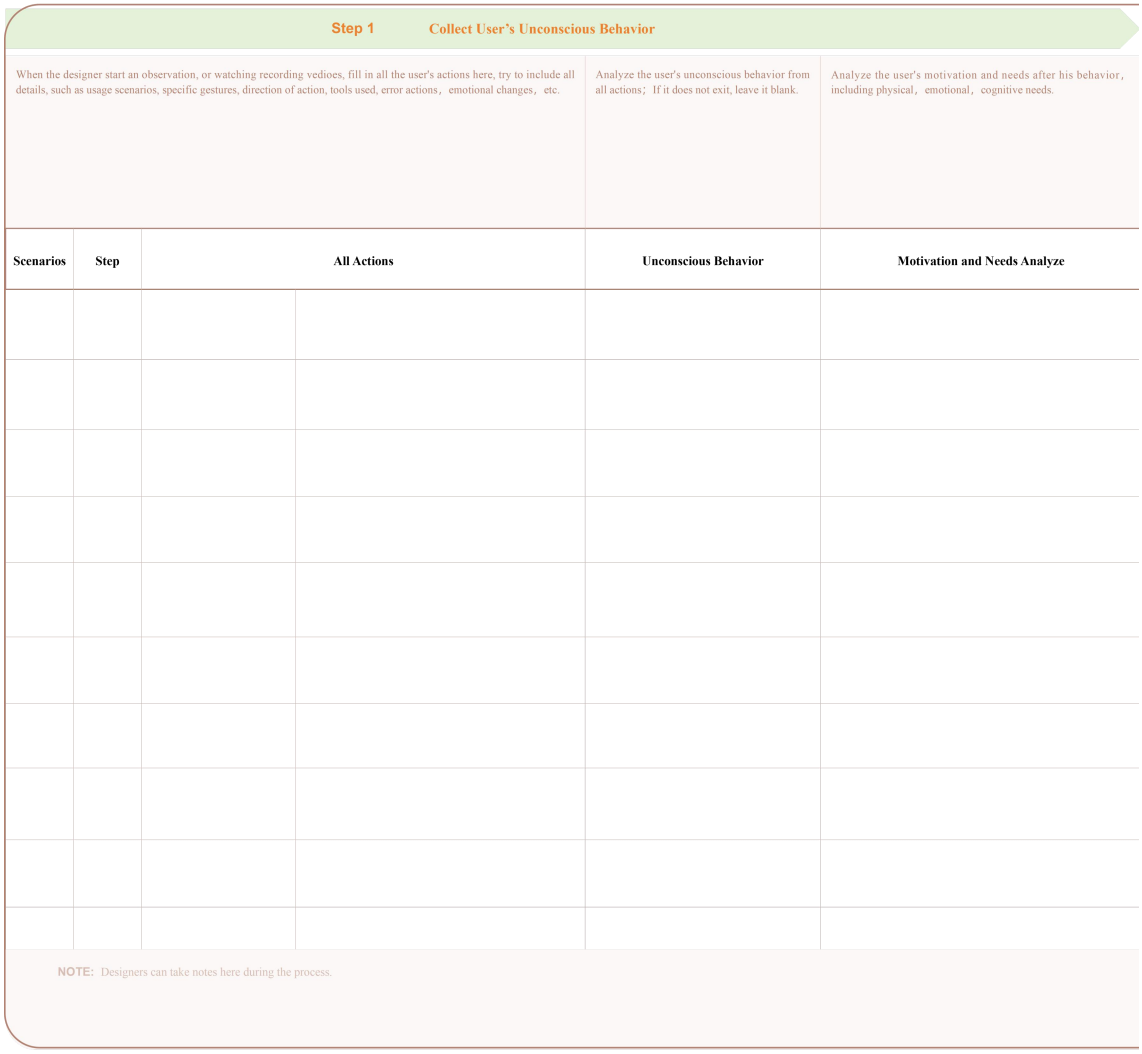


Figure 3.11 Observation Form - Step 1

After collecting user's unconscious behavior, designers should differentiate between factual behaviors witnessed and inferences, speculating the meaning and motivations behind actions (Hanington & Martin, 2019). According to previous study on *Without Thought Design*, we can classify these unconscious behaviors into three aspects: 1. Users' unconscious needs. 2. Users' behaviors, habits and experiences when using the product. 3. Users' emotions and memories related to the product. The conclusion and analysis provide a direct basis for the determinant of design route in the latter step.

3.2.2 Step 2 Determine Design Route

In this step, Designers should organize the objective information collected based on the Project Research Forms and the User Observation Record Form-Step 1, and simultaneously add the designer's subjective judgment to choose three design directions.

Naoto Fukasawa's two design directions for *Without Thought Design* are "Objective Sketching" and "Found Objects" (Takeshi et al, 2016). According to the summary and case study in Chapter 2, these two concepts are simplified. "Objective Sketching" is the idea that a certain subconscious behavior of a user towards a product already exists. Then, the product is endowed with a certain feature to satisfy such behavior and, at the same time, satisfy the user's subconscious needs. The "Found Objects" is the existence of a certain feature of the product that comes from another product (metaphor), and the designer gives this feature to the target product to stimulate the user to make some kind of physical or emotional response. The three design directions are represented by letters A, B, and C. The correspondence between the design methods of *Without Thought Design* is shown in Figure 3.12.

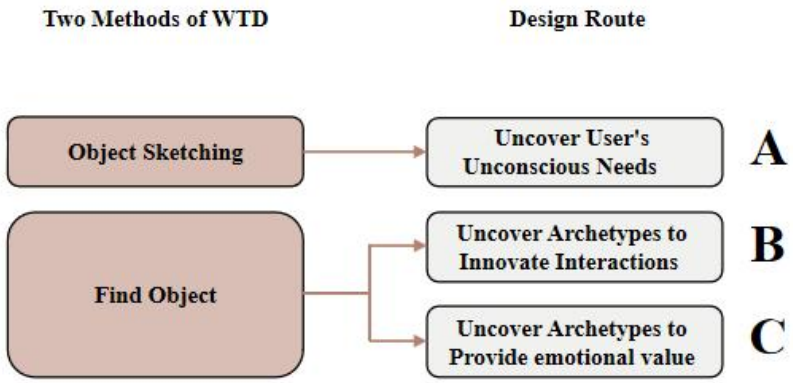


Figure 3.12 Correspondence between the design methods of *Without Thought Design*

According to *6 Rules of Product Design from Maslow's Hierarchy of Needs*, Bradley (2010) created a translation of Maslow's theory- the Design Hierarchy of Needs. As with the original

theory, the basic needs of design must be met first to progress to the next stage. The five tiers of Bradley's theory are functionality, reliability, usability, proficiency, and creativity (Figure 3.13).

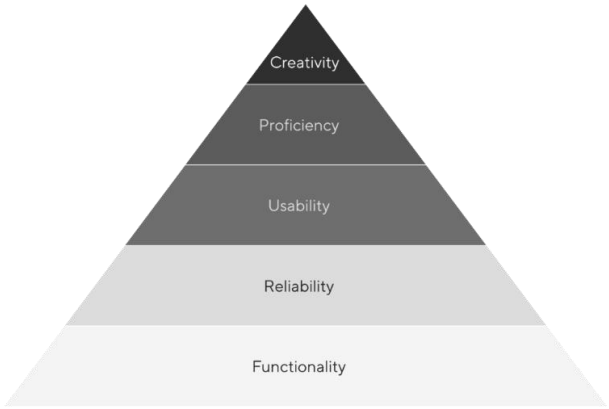


Figure 3.13 Five tiers of Bradley's theory. Adapted from (Bradley et al., 2010)

Correlating these five necessary product attributes to the needs of the product and applying them to the three directions of the unconscious leads to the following relationships (Figure 3.14). (The arrows explain the emphasis relationships but not an absolute correspondence.)

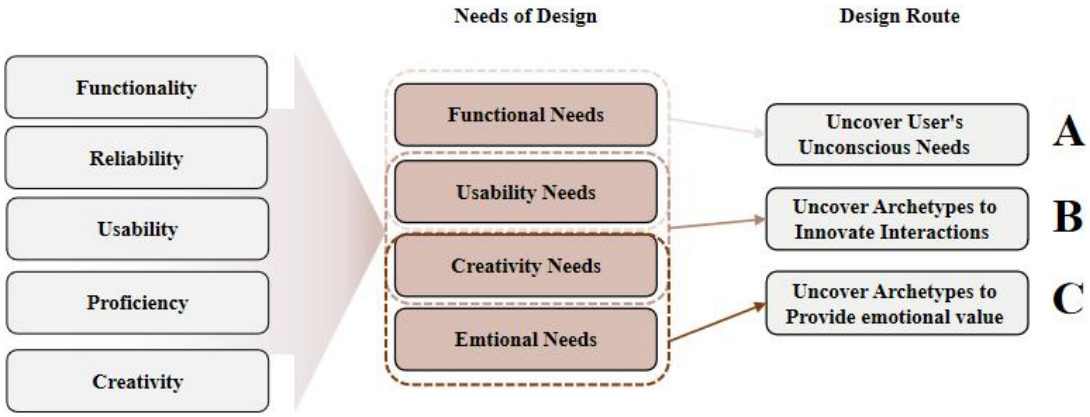
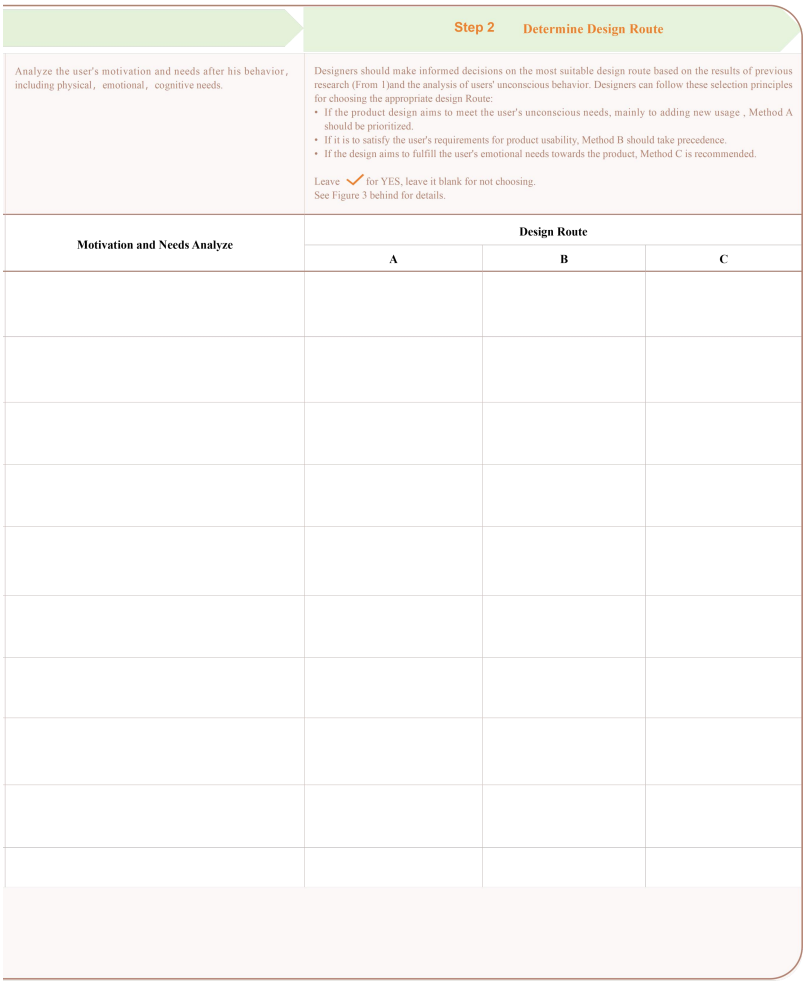


Figure 3.14 Relationships between needs of product, needs of design and design route

User needs can generally be categorized into explicit and implicit types. Implicit needs belongs to the unconscious level, hidden deep in people's hearts, representing people's real needs, but it is not easy to be perceived, and cannot be clearly expressed by users (Hassan & Abdulwahhab, 2018). In contrast, unconscious needs are more deeply hidden and are not actively

detected by the user. Explicit needs is the foundation, and the hidden part is the root. (Augstein et al., 2022). Designers can analyze and deduce users' implicit needs through their unconscious direct expressions and indirect feedback (designers analyze users' habits, behavioral preferences, etc.) (Atterer et al., 2006).

At this stage, designers should already have filled in the motivation and unconscious needs corresponding to the unconscious behavior, in order to distinguish between different kinds of needs, corresponding to the focus of the Design Route.



Step 2 Determine Design Route

Analyze the user's motivation and needs after his behavior, including physical, emotional, cognitive needs.

Designers should make informed decisions on the most suitable design route based on the results of previous research (From 1)and the analysis of users' unconscious behavior. Designers can follow these selection principles for choosing the appropriate design Route:

- If the product design aims to meet the user's unconscious needs, mainly to adding new usage , Method A should be prioritized.
- If it is to satisfy the user's requirements for product usability, Method B should take precedence.
- If the design aims to fulfill the user's emotional needs towards the product, Method C is recommended.

Leave ✓ for YES, leave it blank for not choosing.
See Figure 3 behind for details.

Motivation and Needs Analyze	Design Route		
	A	B	C

Figure 3.15 Observation Form - Step 2

Designers can follow these selection principles for choosing the appropriate design Route and fill in the second part of Observation Form (Figure 3.15):

- If the designers aim to meet the user's unconscious needs, mainly to adding new function and usability, Method A should be prioritized.
- If it is to satisfy the user's requirements for product usability, Method B should take precedence.
- If the design aims to fulfill the user's emotional needs towards the product, Method C is recommended.

At this stage, designers should make informed decisions on the most suitable design route based on the available information and their personal experience, aiming for the desired outcome.

3.3 Phase 3 - Apply Design Route

In the previous step the designer has made a decision by which way the final product will be designed. In this step, the designer needs to carry out the application of the user's unconscious behaviour according to the chosen route. There are three design routes for applying user's unconscious behaviour to the product: **A.** Use the original unconscious behaviour to set up the product And increase the functionality of the product so that it can satisfy the user's unconscious needs; **B.** Find metaphors based on the unconscious behaviour, and give the product similar characteristics of the metaphors to transform and innovate the way of interaction, so that the users do not need additional instructions or guidance for using the product; **C.** Give the product similar visual characteristics to evoke emotional resonance in users.

3.3.1 Design Route A - Find Possible Affordance

This design route belongs to the "Objective Sketching" in *Without Thought Design*, which is the study of the functionality of the product itself, and the purpose of the study is to explore the unconscious needs of users based on their unconscious actions, and to give the product common characteristics, and to improve the functional and usability needs of the product.

Naoto Fukasawa's MUJI Rice Cooker (Figure. 3.16) is innovative in that the lid is designed as a flat surface, with a holder for the rice spoon on top of the lid. The design is inspired by people's habitual action of taking rice from a rice cooker: holding a bowl in the left hand and a rice spoon in the right hand, opening the lid of the rice cooker with the right hand, filling the bowl with rice, and then closing the lid with the right hand. When we find that there is rice stuck to the spoon, there is no place to put the spoon (Figure 3.17). At this point, "finding a suitable place to put the spoon" becomes a potential "unconscious need". The flat lid and the small rest on the lid fulfil this need. The design responds to people's unconscious behaviour of placing objects on a flat surface, and by increasing the availability of the product (the protruding rest that can be placed on the lid), it fulfills an underlying functional need, and perfectly illustrates the harmonious relationship between the product, the environment and the user (Fukasawa, 2007).

Figure 3.16 MUJI Rice Cooker

Figure 3.17 Continuous behavior during the meal

3.3.1.1 Step.1 Summarize User's Unconscious Needs - Functional and Usability

Unconscious needs are derived from analyzing user behavior and interactions with systems or products (Gabrilovich, 2022). In the previous step Transcribe and Analyze User's Unconscious Behavior, all the motivation and needs have already been listed. Therefore, designers need to filter out the users' unconscious functional and usability needs based on the motivation and needs analysis summarized in the Observation Form and fill in the Design Point section. The designer needs to fill in the information that corresponds to the behaviors in the Observation Form (Figure 3.18). This step is to maintain the continuity of these behaviors, facilitating the subsequent feasibility assessment.

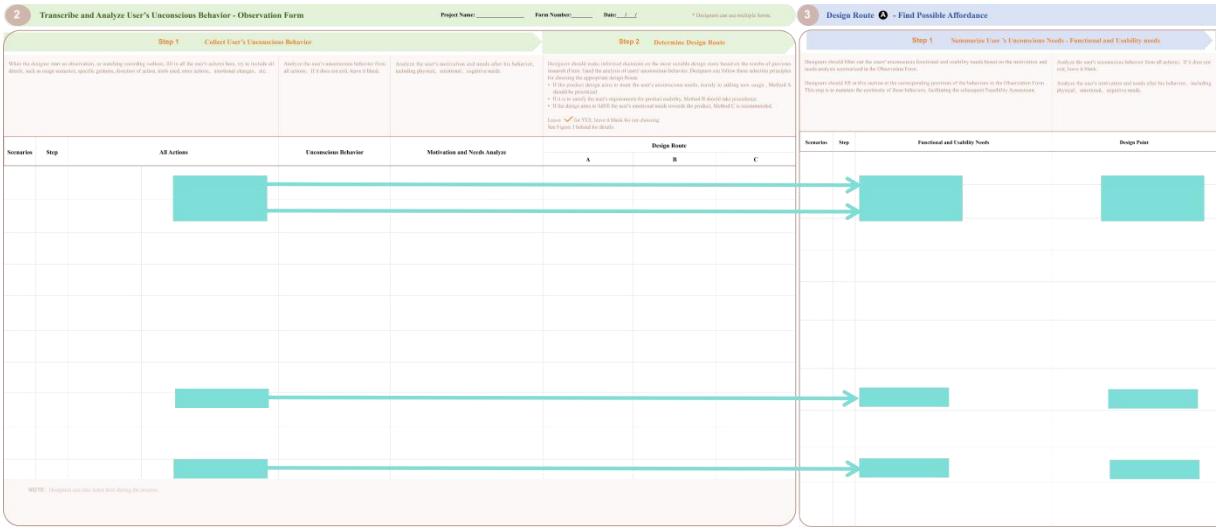


Figure 3.18 Corresponding positions in Observation Form

The content of the Design Point section should be concepts to add functionality and usability. It is not required to develop specific details. The level of completion depends on the designer's personal experience. Designers can also use simple sketches to illustrate their ideas. Designers can refer to Figure 3.19.

Example: The analysis of user's unconscious behaviors when students are using table-chair-bookshelf 3 in 1 furniture in dormitory. The complete table is not displayed.

Unconscious Behaviors	Motivation and Needs	Functional and Usability Needs	Design Opportunity
Use some horizontal books or other objects to block the vertical books	Prevent books from falling down	Need structure on bookshelf	Add a baffle
Cover the pen holder on the table	Prevent the pen barrel from rolling down	Need a place for pen separately	Add a groove to place the pen
Hang the bag with stuff inside on the corner of the table	Habit	Need storage space	Add hooks to table edge
Put clothes on the back of the chair	Habit	Need storage structure	Add hooks on the edge of the desk

Figure 3.19 An example of content in this step. Adapted from (Hao, 2014)

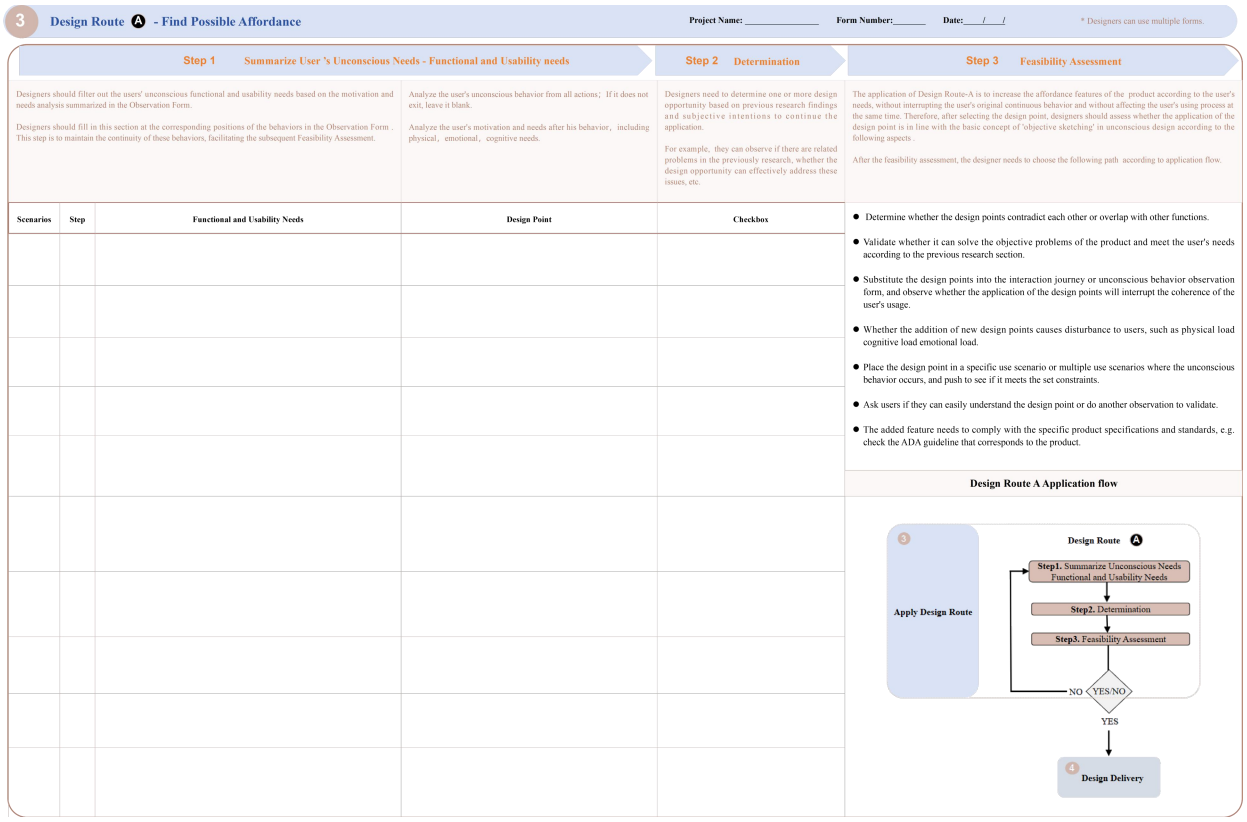


Figure 3.20 Design Route A - Uncover User's Unconscious Needs

3.3.1.2 Step 2 Determine Application

Designers need to check the checkbox (Figure 3.20 - see Appendix for full size forms) to determine one or more design points based on previous research findings and subjective

intentions to continue the application. For example, they can observe if there are related issues in the previous research, whether the design opportunity can effectively address these issues, etc.

3.3.1.3 Step 3 Feasibility Assessment

The application of Design Route A is to increase the affordance features of the product according to the user's needs, without interrupting the user's original continuous behavior and without affecting the user's using process at the same time. Therefore, after selecting design points, designers should assess whether the application of these design points is in line with the basic logic of "objective sketching" in *Without Thought Design* according to the following aspects (Figure 3.21):

- Determine whether the design points contradict each other or overlap with other functions.
- Validate whether it can solve the objective problems of the product and meet the user's needs according to the previous research section.
- Substitute the design points into the interaction journey or unconscious behavior observation form, and observe whether the application of the design points will interrupt the coherence of using process.
- Whether the design points causes burden to users, such as physical load, cognitive load, and emotional load (Sweller, 1988).
- Place the design point in a specific use scenario or multiple use scenarios where the unconscious behavior occurs, and deduce to see if it meets the set constraints.
- Ask users if they can easily understand the design point or do another observation to validate.
- The added feature needs to comply with the specific product specifications and standards, e.g. check the ADA guideline that corresponds to the product.

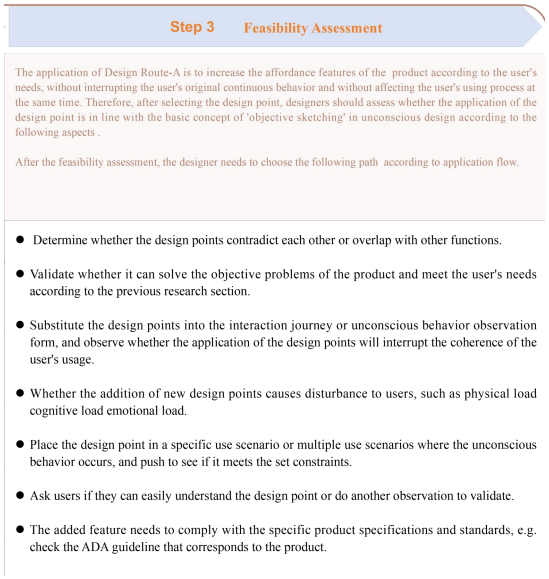


Figure 3.21 Feasibility Assessment

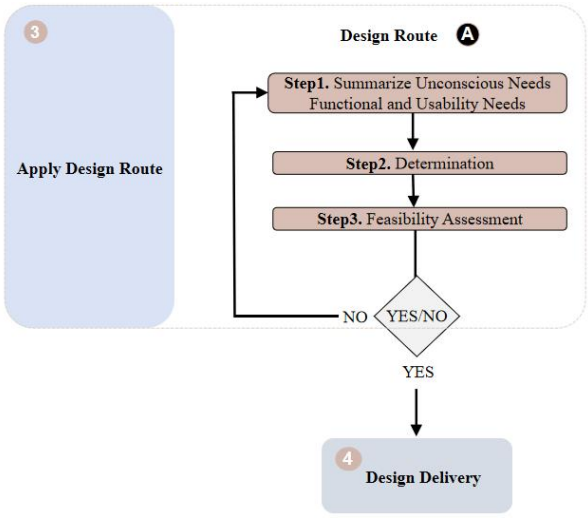


Figure 3.22 Design Route A application flow

After the feasibility assessment, the designer needs to choose the following path (Figure 3.22) depending on the situation. If the design point meets the above criteria, then proceed to the Design Delivery process; conversely, go back to the first step of application and restart. If the designer identifies the need to improve existing features, they can attempt to modify them to better integrate with existing unconscious behaviors. Alternatively, they can try incorporating

them into Design Route-B for further exploration. The focus of this study is on uncovering new needs and adding affordance features, rather than merely addressing existing issues.

3.3.2 Design Route B - Use Intersymbolic Rhetoric to Innovate Interactions

The second type of *Without Thought Design* is "Found Objects", which is essentially a rhetoric between two products. As mentioned in Section 2.3.2.2, the accumulated habits and experience of users when using product A will form a collective unconsciousness archetypes, which can be used as a symbol of product A in the process of rhetoric. According to the summary of existing theories (Figure 2.31), this step has two directions: First, designer starts from the users' unconscious behavior when using product A. Based on the user's unconscious behavior, designers can make partial interaction innovation or improvement. Second, designers subjectively assign the users' unconscious behavior carried by product B to product A, stimulating a completely new interaction process. Regarding the second direction started by the users' unconscious behavior carried by product B, this paper will not discussion in detail

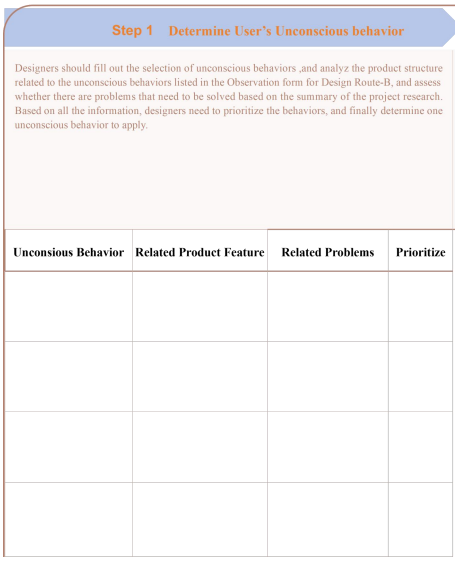
In this step, the designer needs to identify another product, product B, to serve as a '*vehicle'* for the rhetoric to ensure that product A possesses similar partial characteristics as product B. The purpose is to apply some interaction ways from product B to product A, ultimately achieving improvements or innovations in product interaction without increasing user's burden. The key aspect of this route is to deduct and find product B through rhetoric.

In the first step of the design route, designer needs to identify the user's unconscious behavior when they are interacting with the product. After a suitable behavior is identified, designer should considered this behavior as an archetype of the collective unconscious. In the second step, this behavioral archetype should be treated as a symbolic text embodied by the product. The designer should then analyze the meaning of this symbolic text in product A, identify product B

that conveys a similar meaning, examine the carrier of this textual meaning, and substitute this carrier into product A to develop the design scheme. The final phase involves evaluating whether the scheme aligns with the fundamental concept of unconscious behavioral application.

3.3.2.1 Step 1 Determine User's Unconscious behavior

This step begins with the selection of unconscious behaviors based on the summary of the preliminary research and the Observation form. The designer needs to fill out the following sections of the form (Figure 3.23 - see Appendix for full size forms). The selection of unconscious behaviors begins by analyzing the product structure related to the unconscious behaviors listed in the Observation form for Design Route B, and judging whether there are problems that need to be solved based on the summary of the project research. Based on this information, designers need to prioritize the behaviors, and finally determine one unconscious behavior to apply. This step is to select unconscious behaviors purposefully, and designers need to refer to the previous information rather than relying solely on subjective judgments.


Step 1 Determine User's Unconscious behavior

Designers should fill out the selection of unconscious behaviors ,and analyz the product structure related to the unconscious behaviors listed in the Observation form for Design Route-B, and assess whether there are problems that need to be solved based on the summary of the project research. Based on all the information, designers need to prioritize the behaviors, and finally determine one unconscious behavior to apply.

Unconsious Behavior	Related Product Feature	Related Problems	Prioritize

Figure 3.23 The first step of Design Route B

3.3.2.2 Step 2 Intersymbolic Rhetoric - Metonymy

The underlying logic of this step is based on the theoretical foundation of applying product symbols to rhetoric to explain *Without Thought Design* (Figure 2.24) and the summarized relationship of substituting symbolic texts carried by products (Figure 2.31). In this step, the designer uses metonymy from rhetoric. Based on the similarity of the behavioral text meaning between products A and B, the designer identifies product B and then substitutes the textual carrier object. The specific process is illustrated below (Figure 3.24):

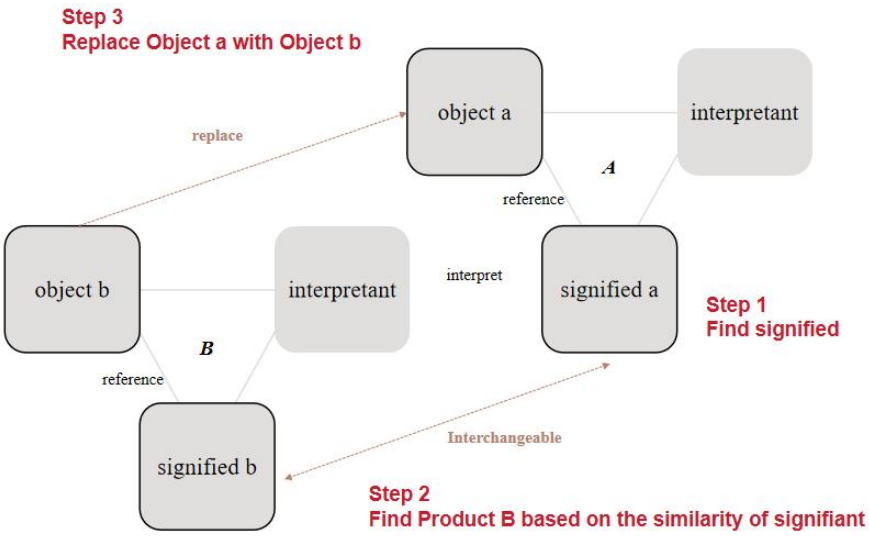


Figure 3.24 Application process of using metonymy

- See the unconscious behavior as a symbolic text carried by the product and identify its signified. The signified refers to the concept or meaning expressed by a symbol, which can be understood as the nature and meaning of the behavior.
- Find product B that carries a similar signified, and identify the object that acts as the carrier of this signified in product B (Figure 2.14). In this step, the designer needs to use their personal and design experience to find product B, with the signified being the essential condition for identifying product B.

- Replace the object that acts as the carrier of the signified in product B for the original object in product A.
- Derive the design scheme for product A based on the replaced object. The schemes derived from the same unconscious behavior should not be used together to avoid contradictions.

The designer needs to fill out the form for step 2 based on the above logic (Figure 3.25 - see Appendix for full size forms).

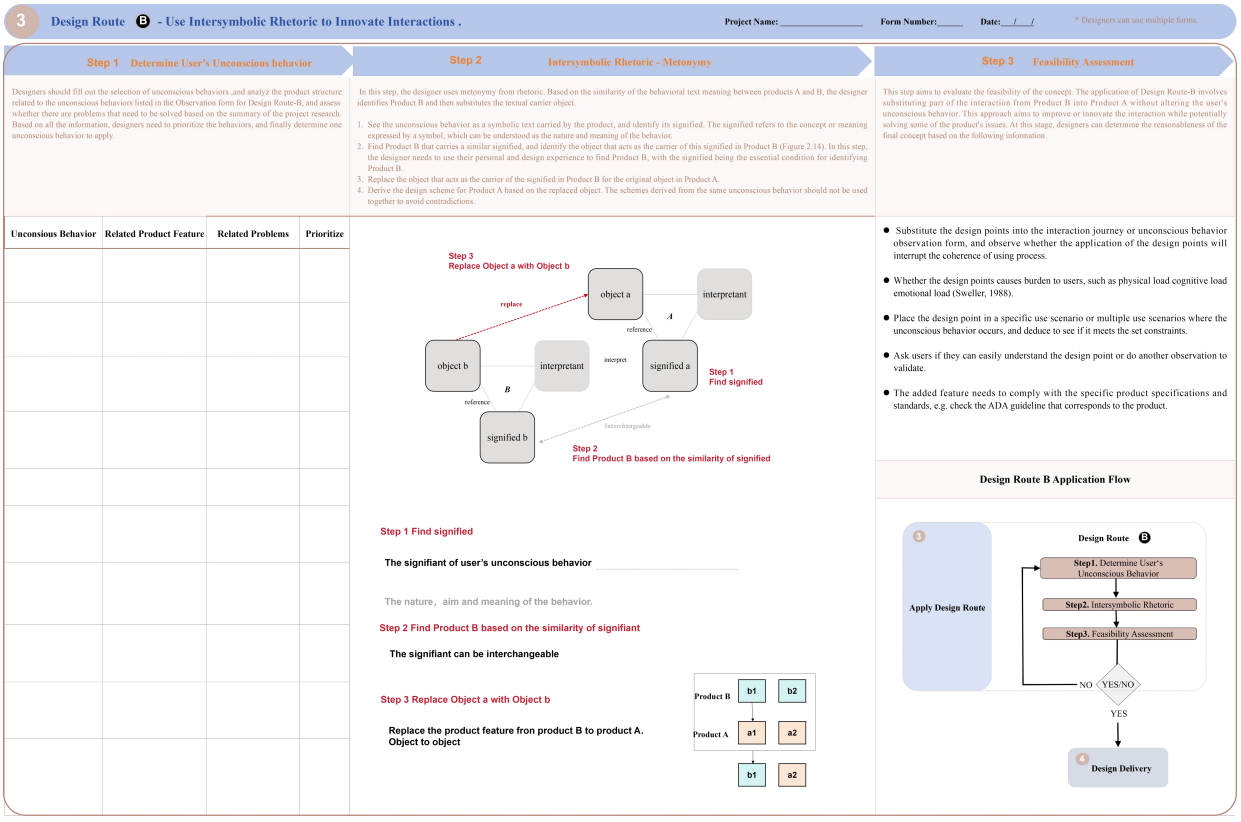


Figure 3.25 Design Route B - Use Intersymbolic Rhetoric to innovate interaction

3.3.2.3 Step 3 Feasibility Assessment

This step aims to evaluate the feasibility of the concept. The application of Design Route B involves substituting part of the interaction from product B into product A without altering the user's unconscious behavior. This approach aims to improve or innovate the interaction while

potentially solving some of the product's issues. At this stage, designers can determine the reasonableness of the final concept based on the following information.

- Substitute the design points into the interaction journey or unconscious behavior observation form, and observe whether the application of the design points will interrupt the coherence of using process.
- Whether the design points causes burdens to users, such as physical load, cognitive load, or emotional load (Sweller, 1988).
- Place the design point in a specific use scenario or multiple use scenarios where the unconscious behavior occurs, and deduce to see if it meets the set constraints.
- Ask users if they can easily understand the design point or do another observation to validate.
- The added feature needs to comply with the specific product specifications and standards, e.g. check the ADA guideline that corresponds to the product.

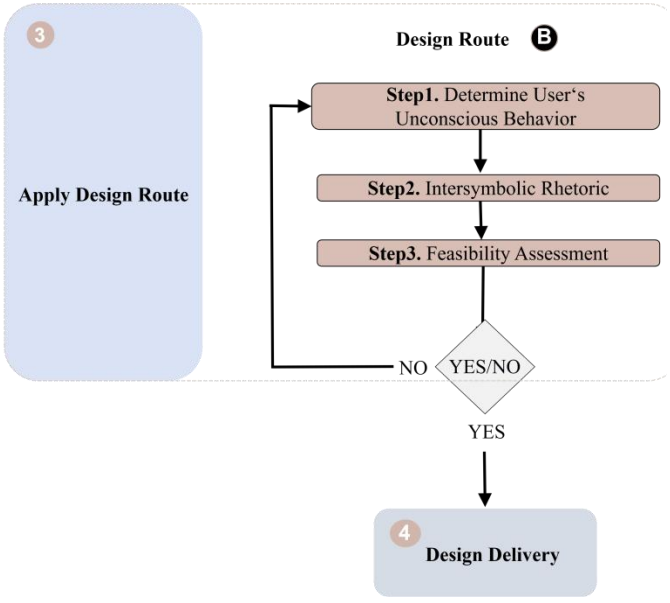


Figure 3.26 Design Route B application flow

After the feasibility assessment, the designer needs to follow the application flow (Figure 3.26) depending on different situations. If the design points pass the above assessment, then proceed to the Design Delivery process; conversely, go back to the second step of application and restart.

3.3.3 Design Route C - Provide Emotional Value

This design route aims to uncover users' deep emotional needs through unconscious behaviors, identify relevant perceptual features, and integrate these features into product A, ultimately providing emotional value to the users. The entire process is built on existing unconscious behaviors and utilizes the theoretical foundations of emotional design, which can be explained through metaphorical rhetoric. The user's unconscious perception here is the collective unconscious behavior, such as cultural symbols, social experience, and so on. The unconscious behavior here is stimulated by sensory input.

3.3.3.1 Step 1 Define Users' Emotional Needs

In related design concepts, the first step for designers is to define the user's emotional needs through research. This paper discusses using unconscious behaviors that already carry emotional needs as the starting point. In this step, designers need to fill in the Design Route-C Application Form (Figure 3.27). See the full size version in Appendices. During the collection and analysis of unconscious behaviors, designers have summarized these behaviors and their corresponding user emotions, including the product parts that carry these unconscious behaviors as shown in Figure 3.14. Designers need to complete the Step 1 section of the form.

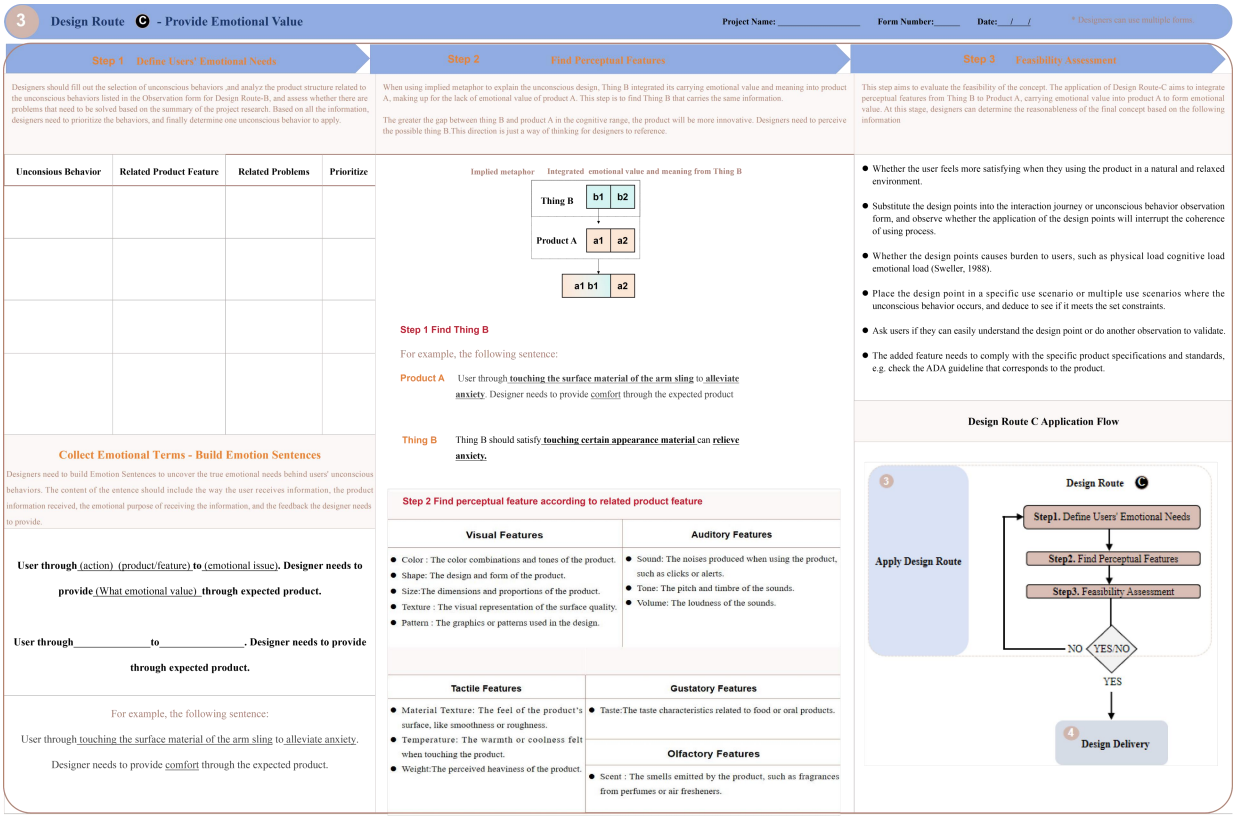


Figure 3.27 Design Route C - Provide Emotional Value

First, designers need to filter and identify the unconscious behaviors that carry emotional needs based on previous research information and refine the related product feature. The selected behaviors should be clear, accurately describable, and belong to collective unconscious behaviors.

Second, to collect emotional terms, designers need to build Emotion Sentences to uncover the true emotional needs behind users' unconscious behaviors.

Donald A. Norman (2007) proposed three levels of emotional design: the Visceral Level, the Behavioral Level, and the Reflective Level. The Visceral Level is a prerequisite for triggering the Behavioral Level. Good design needs to create immediate sensory experiences through the Visceral Level. These immediate sensory experiences are formed through the user's five senses. The sensory organs are the most direct receivers that allow people to get information from

external things, transforming external information into the user's inherent perceptual emotions. This inherent perceptual emotion, as direct consciousness, provides feedback for the steering of behavior (Gibson, 1966). The senses of vision, hearing, smell, touch, and taste are the ways of orienting the perceptual apparatus of the body (Gibson, 1966). The user's five senses correspond to the five ways users receive information at the Visceral and Behavioral Levels of a product.

Therefore, the content of the *Design Sentence* should include the way the user receives information, the product information received, the emotional purpose of receiving the information, and the feedback the designer needs to provide. The way of receiving information corresponds to the user's unconscious behavior, while the product information received corresponds to the part of the product that carries the behavior, and it can also be a feature of the product, for example, a color perceived through vision, a sound identified through hearing, or a texture felt through touch. The emotional purpose of receiving information is the emotional issue or expectation. The feedback that designers need to provide is the emotional value that users can receive from the expected product. The specific example of an Emotion Sentence is as follows:

User through (action) (product/feature) to (emotional issue). Designer needs to provide (emotional value) through expected product.

A specific case of arm sling is shown below (Figure 3.28). The designer finds that when users use the arm sling, they often unconsciously touch the surface of it. At this step, the designer fills in the Emotion Sentence as follows:

User through *touching* *the surface material of the arm sling* to *alleviate anxiety*. Designer needs to provide *comfort* through the expected product.

Figure 3.28 User unconsciously touches arm sling

The designer needs to fill in the corresponding part of Figure 3.29. The design sentence will help summarize the key information about the user's emotional needs, setting the design goals for the following sections.

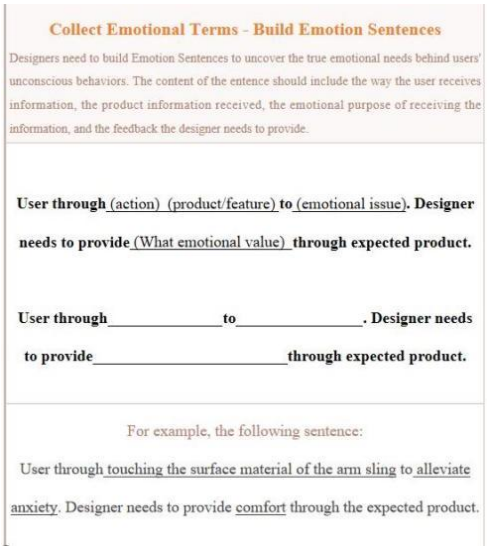


Figure 3.29 Build Emotion Sentences

3.3.3.2 Step 2 Find Perceptual Features

In the previous step, designers can complete the Emotion Sentence to get the unconscious behavior, the corresponding product feature, as well as the emotional value that the designer needs to integrate into the product. At this step, designers need to use this information to explore the design concept. When using implied metaphor to explain the unconscious design, Thing B

integrated its carrying emotional value and meaning into product A, making up for the lack of emotional value of product A. This step is to find Thing B that carries the same information.

The designer has already obtained user's action and the feature of product in the first step. In this step, designers need to evaluate emotional terms by looking for the product feature corresponding to different perceptual feature and assess whether the action and product feature are the corresponding relationship (Figure 3.30). If not, it indicates that the product feature with the emotional gap is wrong, and we need to return to the previous step to define it again.

Visual Features	Auditory Features	Tactile Features	Olfactory Features	Gustatory Features
• Color : The color combinations and tones of the product. • Shape: The design and form of the product. • Size:The dimensions and proportions of the product. • Texture : The visual representation of the surface quality. • Pattern : The graphics or patterns used in the design.	• Sound: The noises produced when using the product, such as clicks or alerts. • Tone: The pitch and timbre of the sounds. • Volume: The loudness of the sounds.	• Material Texture: The feel of the product's surface, like smoothness or roughness. • Temperature: The warmth or coolness felt when touching the product. • Weight:The perceived heaviness of the product.	• Scent : The smells emitted by the product, such as fragrances from perfumes or air fresheners.	• Taste:The taste characteristics related to food or oral products.

Figure 3.30 Classification of perceptual features

After determining the product feature, designs should develop design concept according to the emotion corresponding to each perceptual feature.

In this step, designers also need to integrate into them by looking for Things B with the same information. Looking for Thing B can refer to the following relationships: For example, the users' unconscious behavior of product A, the product feature that triggers emotion, and the emotional needs are touch, appearance material, and the need to relieve anxiety, respectively. Then Thing B should satisfy that touching certain appearance of material can relieve anxiety.

After finding thing B, integrate its perceptual features carrying emotional value into product A to form emotional value. In this way, emotional integration has a chance to innovate creative products. For example, touching a cat can calm emotions, and at the same time users need to

calm their emotions by touching the material. Integrate the emotional feature provided by the cat into the protective features, so that users can get comfort when unconsciously touching (Figure 3.31).

When Jian Zhang (2022) explained this method from the perspective of semiotics, he pointed out that the greater the gap between thing B and product A in the cognitive range, the more innovative the product will be. Designers need to perceive the possible thing B. This direction is just a way of thinking for designers to reference.

Figure 3.31 Arm sling with comfort

3.3.3.3 Step 3 Feasibility Assessment

After completing the preliminary design scheme, the designer needs to assess whether it is feasible according to the following points. Designers needs to choose the following path (Figure 3.32)

- Whether the user feels more satisfied when they use the product in a natural and relaxed environment.
- Substitute the design points into the interaction journey or unconscious behavior observation form, and observe whether the application of the design points will interrupt the coherence of the using process.
- Whether the design points causes burden to users, such as physical load, cognitive load, or emotional load (Sweller, 1988).

- Place the design point in a specific use scenario or multiple use scenarios where the unconscious behavior occurs, and deduce to see if it meets the set constraints.
- Ask users if they can easily understand the design point or do another observation to validate.
- The added feature needs to comply with the specific product specifications and standards, e.g. check the ADA guideline that corresponds to the product.

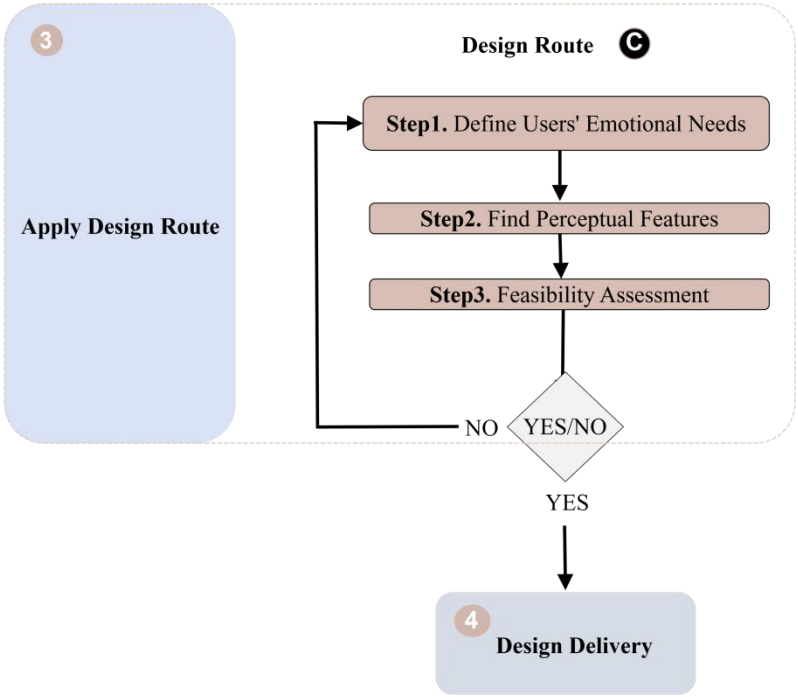


Figure 3.32 Design Route -C application flow

3.4 Design Delivery

After feasibility assessment from each design route the last step of the design process is design delivery. Designers need to develop the full concept by using sketching, 3D modeling, prototyping, testing, e.g. In the process, designers need to consider the following factors:

- User needs and expectations
- Functionality
- Feasibility
- Aesthetic Design

- Flexibility

3.5 Conclusion

In the existing theories, unconscious design has pointed out that the research direction of users' unconscious application is divided into two basic types: "objective sketching" and "found objects". Designer Zhao (2022) proposed using three intersymbolic rhetorical ways to analyze "found objects". After analysis and screening, three design routes were summarized in the guideline. Starting from the process of product interaction design, this chapter subdivides the application of unconscious behavior into three design directions and transforms the theory into operational steps. The designer first conducts the preliminary investigation, obtains the product intention from the perspective of the designer's supervisor, and then after collecting the unconscious behavior analysis, the unconscious behavior is determined and applied through different route in this design guideline.

By using this design guideline，a natural interaction will be created to innovate the product. Whether solving existing problems or just creating an interesting user experience, products designed following this guideline will not burden the users.

Chapter 4: Design Application

This chapter demonstrates an application of glue gun design based on the design guidelines proposed in this thesis. The application uses one of the design routes discussed in Chapter 3 and will end up with two design concepts.

4.1 Project Research

4.1.1 Product Research

The object of the designer's research is a new type of glue gun and the purpose is to innovate the product. First of all, the designer conducts background research using the project research form-1 and completes the first part of the form. The results of the research are shown in Figure 4.1. Through the research, the designer analyzes the performance of several glue guns on the market and collects the ratio of people who use them and the latest trends for the glue guns. The data shows that the demand for glue guns is rising year by year, and users mainly use them for DIY handmade creations. In addition to the basic functions, users' attention to the glue gun is also focused on innovative features such as cordless design and intelligent temperature control.

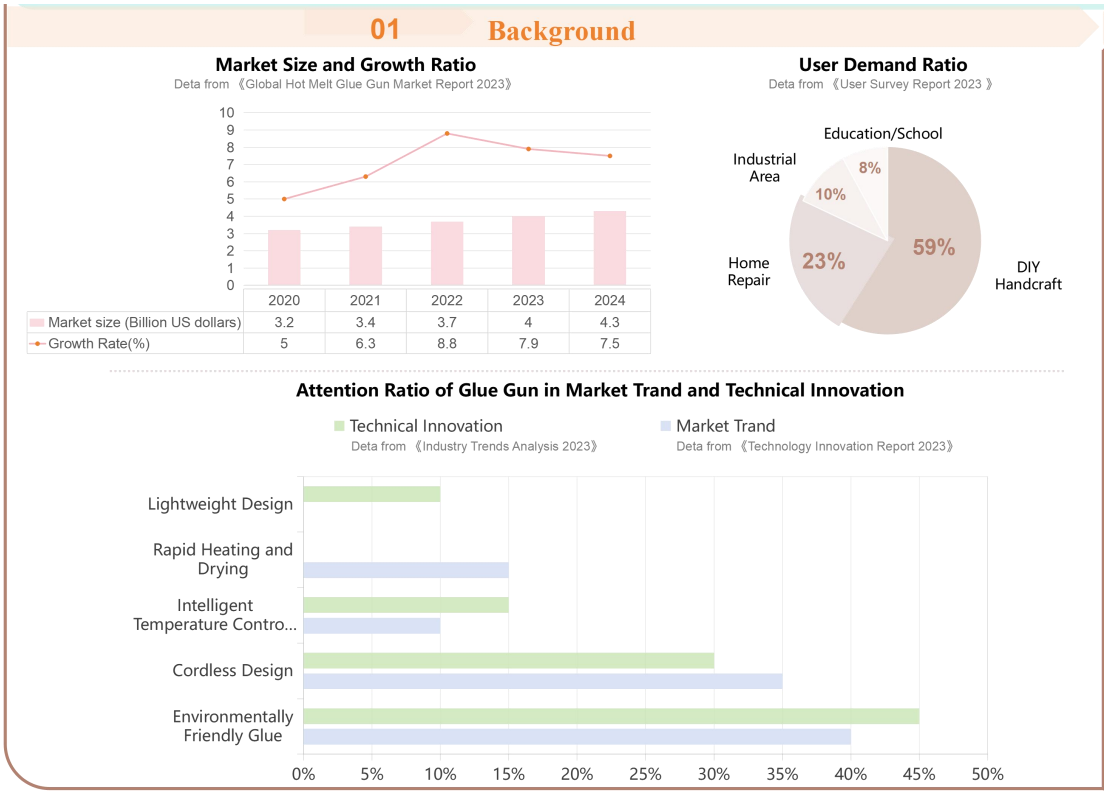


Figure 4.1 Research on Project Background

The Competitor Analysis section (Figure 4.2) is completed by the designer to analyze two traditional glue guns and two new competing products in the market. The designer summarizes the features, innovations, advantages and disadvantages of these products and collects real user feedback. Through this part of the analysis, the designer finds that although the new products are lighter and the wireless design is more convenient, they do not control the speed of glue dispensing like the traditional glue gun, and there is also room for improvement in terms of safety. This information will provide an important reference for designers in the subsequent design concept section.

02 Competitor Analysis

Product Name/ Brand	Price	Basic functions/Advanced features	Selling points / Innovations	Advantage & Disadvantage	Custome Feedback
 **No.1** Hot Glue Gun Amazon-Bukicho	$9.99	Traditional glue gun. Heats up in 1.5-3 minutes LED indicator light Removable stand holds the glue gun stable Requires power connection to use	Small size Good ergonomic design Strong Adhesiveness Easy to toggle the On/Off switch	The ergonomic rubber handle and trigger offer a comfortable grip, portable and lightweight design can help to use it easily and reduced fatigue. Limit scenarios,Hard to control the heated glue.	Need to turn off in advance to stop melting the glue.Limit protection 
 **No.2** Full Size Cordless Glue Gun	$68.99	Temp control(212-392°F). LCD Digital Display Dripless & Anti-Scald Nozzles Cordless. 1 Lithium Ion batteries required Heats up in 2 minutes	Accurate Temp Adjust Not only for DIY, crafts and home repairs but also heavy-duty construction or woodworking projects.	Carry battery, convenient for projects requiring frequent movements or quick finish. Work for Limit Battery, not Interchangeable with Other Brands.	Not friendly for entry-level user. A little expensive. Heavy for longtime-working.
 **No.3** Cordless Glue Pan Amazon-Huepar	$29.97	Cordless powered by LI-ION battery Intelligent Chip Control, an automatic glue stick feeding system,turn off automatically after 30 seconds of inactivity Heat-up in 10 seconds, LED indicator light	Multipurpose Cordless & Ergonomic Design Intelligent Chip Control Rapid Heating USB Rechargeable Li-ion Battery	Smart system.Smiple interaction,Friendy for entry-level user. Portable.Easy and comfortable to hold. Multiple scenarios Limit protection. Limit speed.	"Only one speed,On a normal glue gun you can pull the trigger harder to get a thicker bead by putting glue through faster."
 **No.4** Cordless Glue Pan Amazon-Doinow	$19.9	Cordless powered by LI-ION battery Intelligent Chip Control, It powers off Automatically after 100s. Heat-up in 10 seconds. LED indicator light	Ergonomic Innovation Design USB-C rechargeable design Insulated structure Rapid Heating	The pen-shaped design is easy to hold and control, providing a comfortable grip feeling. Limit protection. Limit speed.	Glue stick outside is very easy to be bent when holding it, which sometims requires manual adjustment to prevent clogging.

Figure 4.2 Research on Project Background

4.1.2 Research on Target User

To better understand the target users, the designer creates two different user personas according to the user groups in the background research (Figure 4.3). The differences in their professional level and usage scenarios also lead to their different expectations for products. Designers can refer to the differences between the two personas to develop the design at later stages.

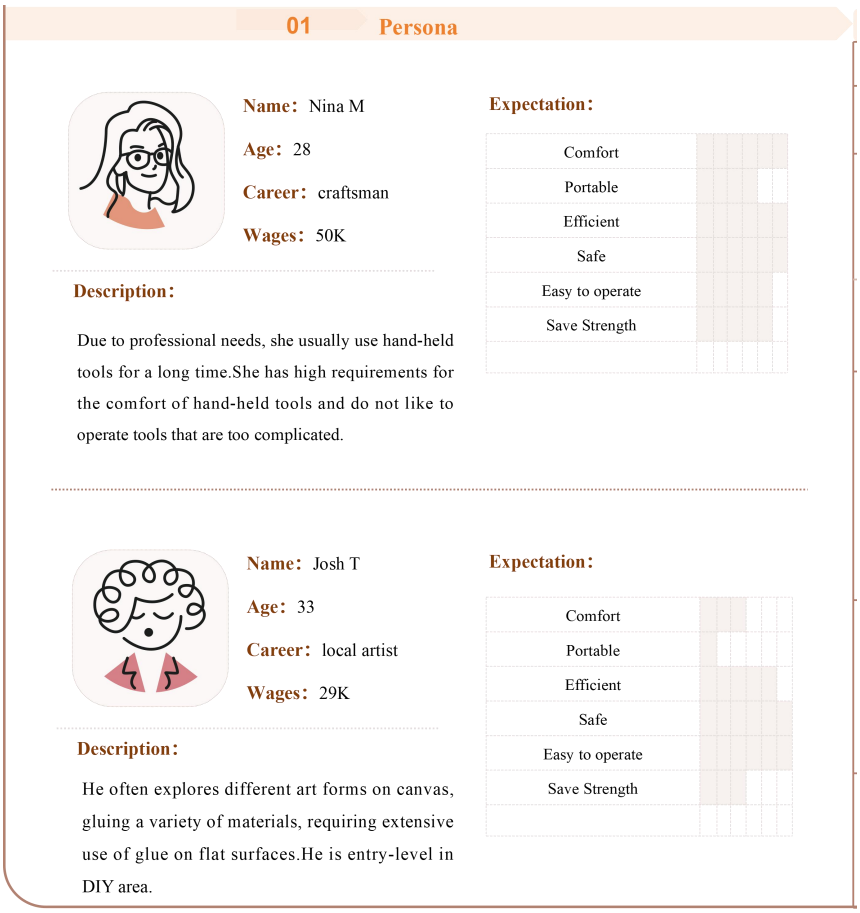
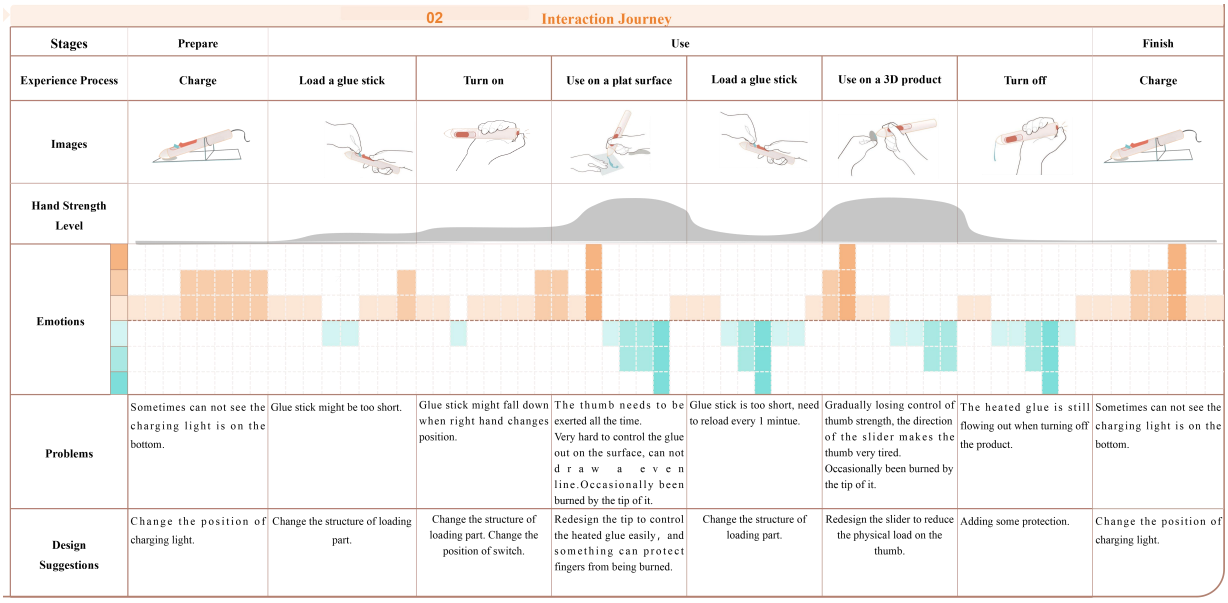


Figure 4.3 User Persona

After the above process, the designer has a clear understanding of the user group's orientation. In order to have a detailed understanding of the target user's experience during the use process, the designer creates an Interaction Journey (Figure 4.4) though observation of a target user. The designer divides the user's process of using the glue gun into three stages: the preparation stage, the use stage, and the end stage. Hand strength levels were analyzed according to each experiential process, and attention was paid to changes in the user's emotions. The designer analyzes the existing problems from the user's perspective and makes design recommendations. This step aimed to focus on the overall user experience. The designer finds that the user's hand strength level increases significantly with the sliding operation during the use process, while the mood gradually decreases. Therefore, the glue gun has more room for innovation during the use

phase. The designers choose the use process as the starting point for studying the unconscious behavior of the user.

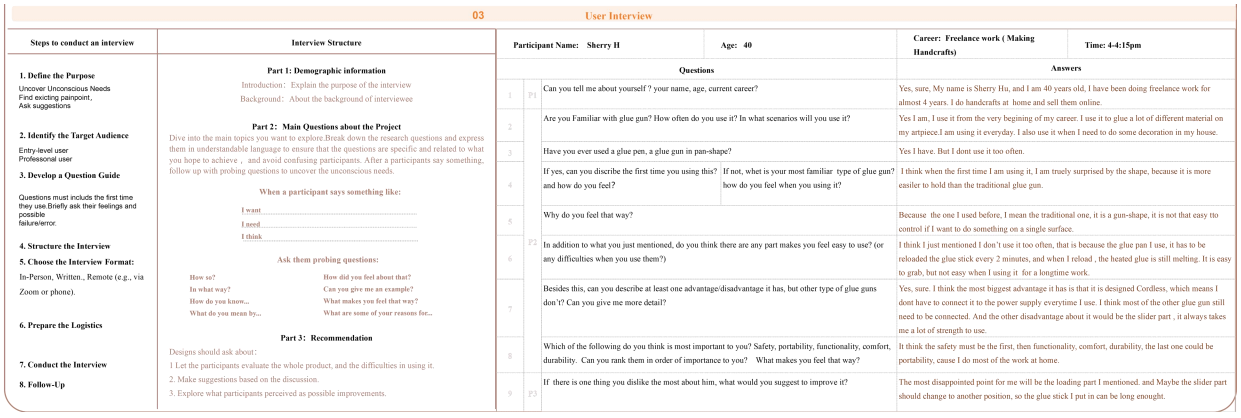


02 Interaction Journey

Stages	Prepare	Use						Finish
Experience Process	Charge	Load a glue stick	Turn on	Use on a plat surface	Load a glue stick	Use on a 3D product	Turn off	Charge
Images								
Hand Strength Level								
Emotions								
Problems	Sometimes can not see the charging light is on the bottom.	Glue stick might be too short.	Glue stick might fall down when right hand changes position.	The thumb needs to be exerted all the time. Very hard to control the glue out on the surface, can not draw a even line.Occasionally been burned by the tip of it.	Glue stick is too short, need to reload every 1 mintue.	Gradually losing control of thumb strength, the direction of the slider makes the thumb very tired. Occasionally been burned by the tip of it.	The heated glue is still flowing out when turning off the product.	Sometimes can not see the charging light is on the bottom.
Design Suggestions	Change the position of charging light.	Change the structure of loading part.	Change the structure of loading part. Change the position of switch.	Redesign the tip to control the heated glue easily, and something can protect fingers from being burned.	Change the structure of loading part.	Redesign the slider to reduce the physical load on the thumb.	Adding some protection.	Change the position of charging light.

Figure 4.4 Interaction Journey

In order to dig deeper into individual user's personal experiences, feelings, and motivations, designers can refer to the user interview section in Project Research Form-2 to conduct an interview. Figure 4.5 shows an example of an interview with a glue gun user.



03 User Interview

Steps to conduct an interview

1. Define the Purpose
Uncover Unconscious Needs
Find exciting painpoint,
Ask suggestions
2. Identify the Target Audience
Entry-level user
Professonal user
3. Develop a Question Guide
Questions must include the first time they use.Briefly ask their feelings and possible failure/error.
4. Structure the Interview
5. Choose the Interview Format:
In-Person, Written., Remote (e.g., via Zoom or phone).
6. Prepare the Logistics
7. Conduct the Interview
8. Follow-Up

Interview Structure

Part 1: Demographic information
Introduction: Explain the purpose of the interview
Background: About the background of interviewee

Part 2: Main Questions about the Project
Dive into the main topics you want to explore.Break down the research questions and express them in understandable language to ensure that the questions are specific and related to what you hope to achieve , and avoid confusing participants. After a participants say something, follow up with probing questions to uncover the unconscious needs.

When a participant says something like:
I want
I need
I think

Ask them probing questions:
How so? / How did you feel about that?
In what way? / Can you give me an example?
How do you know... / What makes you feel that way?
What do you mean by... / What are some of your reasons for...

Part 3: Recommendation
Designs should ask about:
1.Let the participants evaluate the whole product, and the difficulties in using it.
2. Make suggestions based on the discussion.
3. Explore what participants perceived as possible improvements.

Participant Name: Sherry H **Age:** 40 **Career:** Freelance work (Making Handcrafts) **Time:** 4-4:15pm

		Questions	Answers
1	P1	Can you tell me about yourself ? your name, age, current career?	Yes, sure, My name is Sherry Hu, and I am 40 years old, I have been doing freelance work for almost 4 years. I do handcrafts at home and sell them online.
2		Are you Familiar with glue gun? How often do you use it? In what scenarios will you use it?	Yes I am, I use it from the very begining of my career. I use it to glue a lot of different material on my artpiece.I am using it everyday. I also use it when I need to do some decoration in my house.
3		Have you ever used a glue pen, a glue gun in pan-shape?	Yes I have. But I dont use it too often.
4		If yes, can you discribe the first time you using this? and how do you feel? / If not, whet is your most familiar type of glue gun? how do you feel when you using it?	I think when the first time I am using it, I am truely surprised by the shape, because it is more easiler to hold than the traditional glue gun.
5		Why do you feel that way?	Because the one I used before, I mean the traditional one, it is a gun-shape, it is not that easy tto control if I want to do something on a single surface.
6	P2	In addition to what you just mentioned, do you think there are any part makes you feel easy to use? (or any difficulties when you use them?)	I think I just mentioned I don't use it too often, that is because the glue pan I use, it has to be reloaded the glue stick every 2 minutes, and when I reload , the heated glue is still melting. It is easy to grab, but not easy when I using it for a longtime work.
7		Besides this, can you describe at least one advantage/disadvantage it has, but other type of glue guns don't? Can you give me more detail?	Yes, sure. I think the most biggest advantage it has is that it is designed Cordless, which means I dont have to connect it to the power supply everytime I use. I think most of the other glue gun still need to be connected. And the other disadvantage about it would be the slider part , it always takes me a lot of strength to use.
8		Which of the following do you think is most important to you? Safety, portability, functionality, comfort, durability. Can you rank them in order of importance to you? What makes you feel that way?	It think the safety must be the first, then functionality, comfort, durability, the last one could be portability, cause I do most of the work at home.
9	P3	If there is one thing you dislike the most about him, what would you suggest to improve it?	The most disappointed point for me will be the loading part I mentioned. and Maybe the slider part should change to another position, so the glue stick I put in can be long enought.

Figure 4.5 Example of an Interview with a Glue Gun Use

4.1.3 Design Expectations

By filling out Step 3 of the Project Research Form-2, the designer summarizes the preliminary research. First of all, the designer fills out the product character in each quadrant according to the

innovation point of the glue gun in the market and the user's concern about the glue gun. They are product safety, ergonomic design, high efficiency, advanced function, simple interaction, speed level, rapid heating, and indicator system. Next, the designer visualizes the whole Spider Chart according to several products in the competitor analysis. As shown in Figure 4.6, the designer combined the user's expectations for the above points, market demand, and other research information to locate the target product, and initially thinks that the product needs to first be a good ergonomic design, while reducing complex interaction, to be friendly to entry-level users.

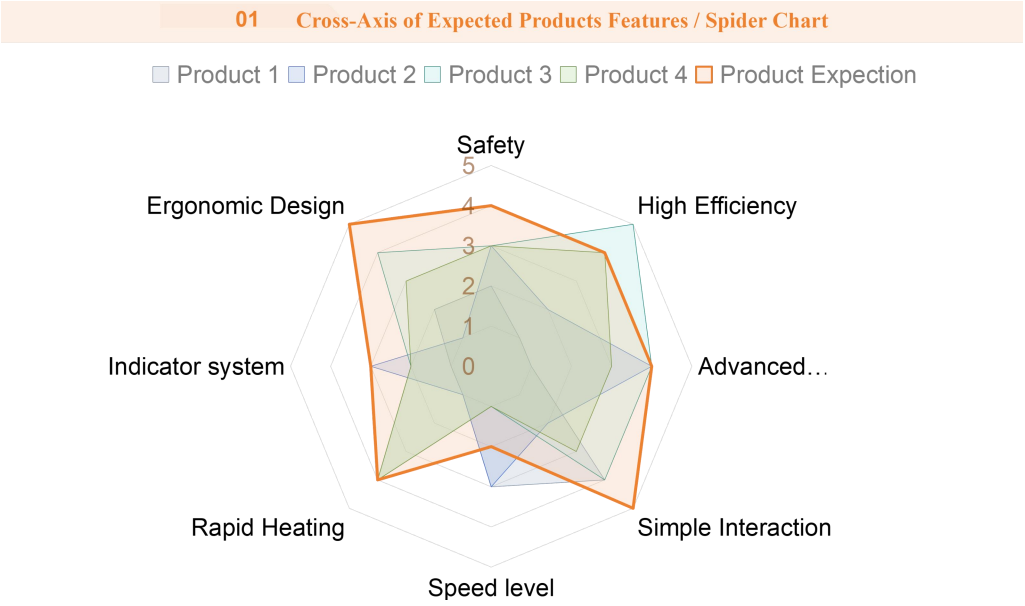


Figure 4.6 Spider Chart of Expected Products Features

The final step of project research is to summarize previous information and fill in design expectations. The designer roughly categorizes the content to be filled in according to the kind of user expectations and the load generated, as shown in figure 4.7. This part is to provide a reference when the designer chooses the design route and subsequently develops the design concept. In this case, the designer lists some expectations about functionality, usability, and

creativity, but does not find the user's targeted emotional needs. Useful information includes the following:

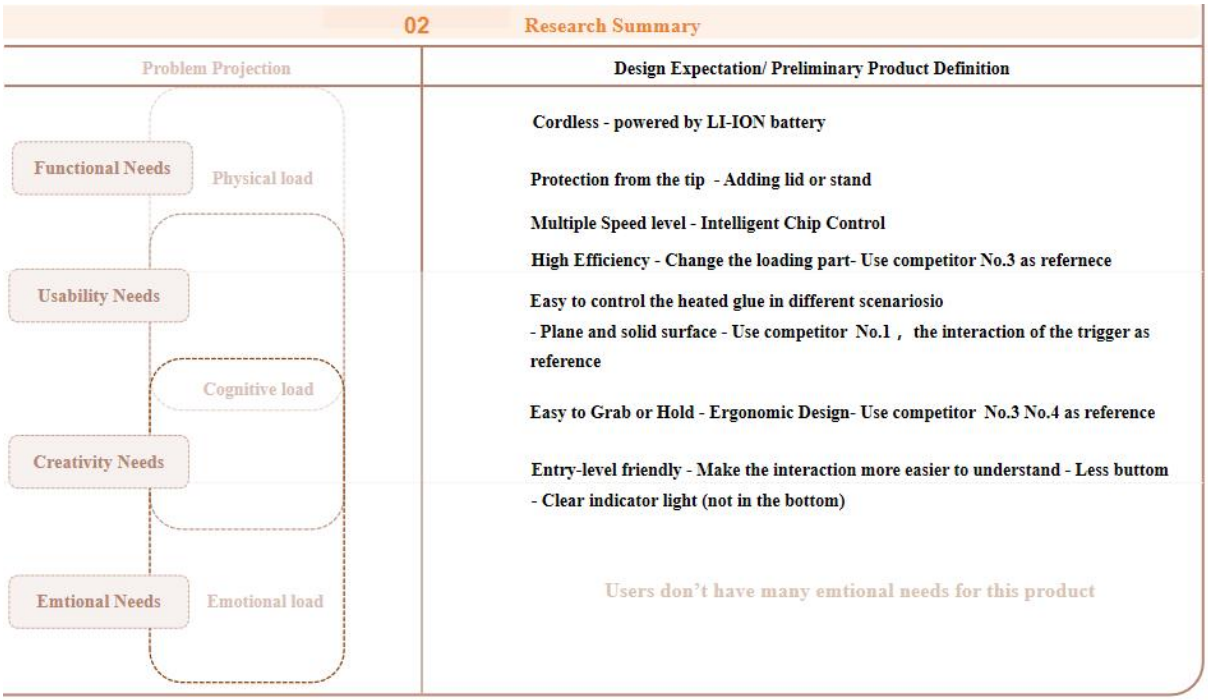


Figure 4.7 Summary of Project Research

4.2 Transcribe and Analyze User's Unconscious Behavior

4.2.1 Collect User's Unconscious Behavior

After completing the preliminary research, the designer observes and analyzes the user's unconscious behavior. The designer reviews the preliminary research and finds that there are many problems and potential design points in the use of the glue gun. In this case, the designer chooses to observe the process when users use the glue gun in order to capture the user's unconscious behavior. First, the designer uses an observation form to collect all the actions of the user when using the glue gun, and further analyzes these actions to list the ones that are unconscious actions and analyzes the motivations and needs in them (Figure 4.8).

Step 1 **Collect User's Unconscious Behavior**

When the designer start an observation, or watching recording vedioes, fill in all the user's actions here, try to include all details, such as usage scenarios, specific gestures, direction of action, tools used, error actions, emotional changes, etc.

Analyze the user's unconscious behavior from all actions; If it does not exit, leave it blank.

Analyze the user's motivation and needs after his behavior, including physical, emotional, cognitive needs.

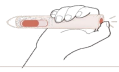
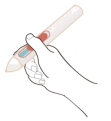
Scenarios	Step	All Actions		Unconscious Behavior	Motivation and Needs Analyze
Prepare	1		Using right hand to pickup the glue gun.	Right hand	Habit
	2		Right hand holding the product. Left hand insert th the glue stick into the loading point.		
Turn on	3		Hold the product with his right hand and turn on the switch with his thumb.		
	4		Hold the glue gun with his right hand and place his thumb on the slider.	Holding the glue gun like holding a pen. Hold with his thumb and index finger.	Habit & Experience
			Moving his thumb from up to down , push down the slider until the glue is beening heated and ready to use.		
On flat surface	5		After the glue emerges from the tip of the pen, hold the pen with his right hand and use it downward.	Press down the glue gun.	Draw the liquid glue on the paper
			The tip of the glue pen slides on the paper , the user attempts to draw an even line, but failed.	Press down and slide	Draw the liquid glue on the paper
Prepare	6		Right hand holding the product. Left hand insert the glue stick to reload.		
	7		Moving his thumb from up to down , push down the slider until the glue is beening heated and ready to use. It was a bit of a struggle to keep his thumb strained and keep pushing the slider.	Holding the glue gun like holding a pen.Using thumb to active the heating funcation.	To activate the heating function.
On 3D product	8		The user tries to glue together 2 pieces of 3D products, but once the object is above a certain height, the hand loses its support point, and it is difficult for the thumb to exert force.	Holding the glue gun like holding a pen.Using thumb to active the heating funcation.	To activate the heating function.
Turn off	9		Hold the product with his right hand and turn off the switch with his thumb. Heated glue continues to flow out. User don't know how to deal with it.		

Figure 4.8 Observation Form - Step 1

According to the observation and summary, the unconscious actions of users include the following:

- Users preferred to use their right-hand
- Users will unconsciously use a pen grip gesture when using a glue gun, holding it with the thumb and index finger while the thumb triggers the heat switch.
- When users use a glue gun on a flat surface, they usually press downward to apply liquid glue, and pan and slide the pen grip gesture on a flat surface.

Also, based on the user's small movements, the designer finds that the user directly knows that they can use the product like a pen without being reminded that the slider needs to be pressed down, but it does take longer to move the slider up and down with the thumb due to the wrong direction of the thumb's force. Also, if the user keeps using it, the glue stick becomes too short, and the user needs to reload the glue stick several times.

4.2.2 Determine Design Route

Next, the designer determines the design route for each action based on the above information and previous project research. Among other things, the designer focuses mainly on the user's unconscious actions (Figure 4.9). For example, previous research has shown that competing products on the market already feature smart chip control to support automatic glue feeding. Therefore, the action of repeatedly changing the glue stick can be recognized as the design route A. However, since the action is not unconscious action, it can only be used as a reference for functional innovation solutions.

2 **Transcribe and Analyze User's Unconscious Behavior - Observation Form**

Project Name: Glue gun Form Number: 1 Date: 06 / 13 / 24 * Designers can use multiple forms.

Step 1 Collect User's Unconscious Behavior

When the designer start an observation, or watching recording vedioes, fill in all the user's actions here, try to include all details, such as usage scenarios, specific gestures, direction of action, tools used, error actions, emotional changes, etc.

Analyze the user's unconscious behavior from all actions; If it does not exit, leave it blank.

Analyze the user's motivation and needs after his behavior, including physical, emotional, cognitive needs.

Step 2 Determine Design Route

Designers should make informed decisions on the most suitable design route based on the results of previous research (From 1)and the analysis of users' unconscious behavior. Designers can follow these selection principles for choosing the appropriate design Route:

- If it aims to meet the user's unconscious needs, mainly to adding new function , Method A should be prioritized.
- If it is to satisfy the user's requirements for product usability, Method B should take precedence.
- If the design aims to fulfill the user's emotional needs towards the product, Method C is recommended.

Leave ✓ for YES, leave it blank when not choosing.

Scenarios	Step	All Actions	Unconscious Behavior	Motivation and Needs Analyze	Design Route A	Design Route B	Design Route C
Prepare	1	 Using right hand to pickup the glue gun.	Right hand	Habit		✓	
	2	 Right hand holding the product. Left hand insert th the glue stick into the loading point.			✓		
Turn on	3	 Hold the product with his right hand and turn on the switch with his thumb.				✓	
	4	 Hold the glue gun with his right hand and place his thumb on the slider.	Holding the glue gun like holding a pen. Hold with his thumb and index finger.	Habit & Experience		✓	
		Moving his thumb from up to down , push down the slider until the glue is beening heated and ready to use.				✓	
On flat surface	5	 After the glue emerges from the tip of the pen, hold the pen with his right hand and use it downward.	Press down the glue gun.	Draw the liquid glue on the paper		✓	
		The tip of the glue pen slides on the paper , the user attempts to draw an even line, but failed.	Press down and slide	Draw the liquid glue on the paper		✓	
Prepare	6	 Right hand holding the product. Left hand insert the glue stick to reload.			✓		
	7	 Moving his thumb from up to down , push down the slider until the glue is beening heated and ready to use. It was a bit of a struggle to keep his thumb strained and keep pushing the slider.	Holding the glue gun like holding a pen.Using thumb to active the heating funcation.	To activate the heating function.		✓	
On 3D product	8	 The user tries to glue together 2 pieces of 3D products, but once the object is above a certain height, the hand loses its support point, and it is difficult for the thumb to exert force.	Holding the glue gun like holding a pen.Using thumb to active the heating funcation.	To activate the heating function.	✓		
Turn off	9	 Hold the product with his right hand and turn off the switch with his thumb. Heated glue continues to flow out. User don't know how to deal with it.			✓		

Figure 4.9 Observation Form - Step 2

4.3 Apply Design Route

After determining the design route, the designer chose Design Route B for use. The rationale for this choice was that after analyzing the functionality-related issues, the designer found that problems such as the repeated reloading of the glue gun could be improved by adding an existing advanced function-feeding system and that fully automated operation would not interrupt the user's basic flow of use. The user's need for safety can also be accomplished through simple design. In contrast, the unconscious behavior of designers in determining the importance of several steps in the use of a product is more worthy of reference to innovate product interaction.

Therefore, the designer chose Design Route B to carry out the application of users' unconscious behavior, and filled in the first step of the Design Route B Application Form (Figure 4.10 - see Appendix for full size forms).

Step 1 Determine User's Unconscious behavior

Designers should fill out the selection of unconscious behaviors ,and analyz the product structure related to the unconscious behaviors listed in the Observation form for Design Route-B, and assess whether there are problems that need to be solved based on the summary of the project research. Based on all the information, designers need to prioritize the behaviors, and finally determine one unconscious behavior to apply.

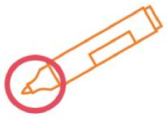
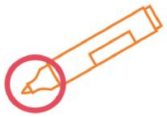
Unconsious Behavior	Related Product Feature	Related Problems	Prioritize
Hold the product with his thumb and index finger 	The shape of pan, the silder 	The silder is hard to push	2
Put thumb on the slide to active the heating system 	The shape of pen, the silder loading system 	Need reload the glue stick for multiple times. Can not control the glue speed	1
Press down the glue gun to flow liquid glue 	The tip of glue gun Heating system 	Can not control the glue speed Not safe enough	3
Press down the glue gun and slide to flow liquid glue 	The tip of glue gun Heating system 	Can not control the glue speed Not safe enough	4

Figure 4.10 Design Route B - Step 1

The designer analyzes the product structure or other features corresponding to the unconscious behavior, and makes a simple ranking based on the previous summary of related pain points, in order to have a simple reference for the designer to prioritize the requirements when choosing. In

this step, the designer mainly studies the thumb touch when holding the glue gun and the unconscious action of pressing down to use it.

4.3.1 Apply Unconscious Behavior 1

The designer applies the concept of metonymy from rhetoric to the unconscious behavior of the thumb when holding a glue gun. Following the instructions in the application form, the designer first selects the act of the thumb pressing while holding the glue gun as an archetype of the collective unconscious, which belongs to the product system of Product A - the glue gun, as shown in Figure 4.11.

Firstly, the designer identifies the signified of ‘thumb pressing’ as ‘press can/to activate the system.’ Secondly, according to the metonymy formula, the designer searches for a product B that carries a similar signified, based on the similarity and interchangeability of the signified. The designer, drawing on their own experience, realizes that traditional glue pens also have the signified ‘press can/to activate.’ Thus, in step three, Object B is a product feature that carries this signified. In traditional glue pens, the trigger serves as the product feature that embodies the signified ‘thumb pressing to activate.’ Therefore, the designer replaces Object A in the product A system with Object B, integrating it as part of the product A system.

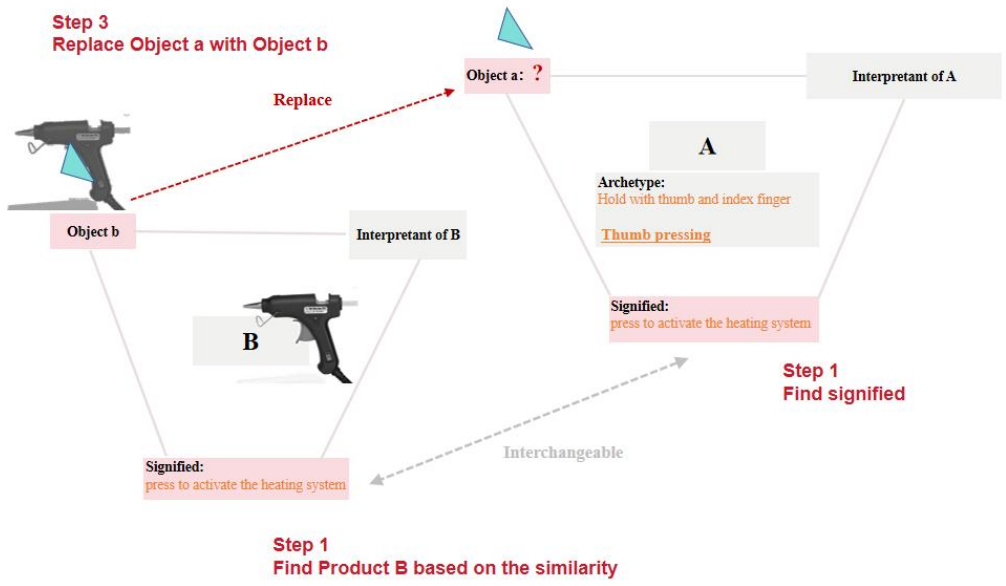


Figure 4.11 Using Metonymy formula to Apply Unconscious Behavior 1

Thus, the designer obtains a glue gun with a trigger instead of a slider. The designer carries out preliminary design point conceptualization. After a feasibility assessment, the designer substitutes the design concept into the key use flow generated by the unconscious behavior (Figure 4.12) and concludes that it is feasible to move the trigger to the product component generated by the thumb's unconscious action, without interrupting the existing unconscious action.

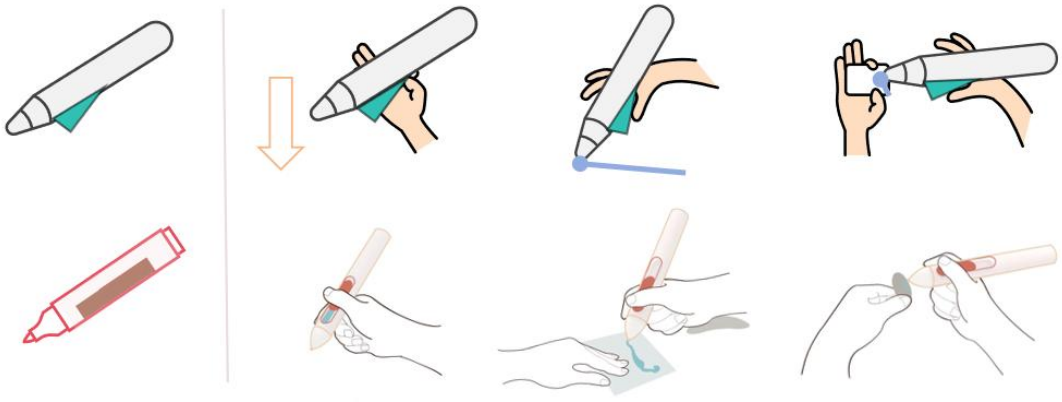


Figure 4.12 Substitute the design concept into the interaction journey to do Feasibility Assessment

4.3.2 Apply Unconscious Behavior 2

The designer applies the application to the unconscious behavior of pressing down on a flat surface when using a glue gun. According to the instructions in the Application Form, the designer first selects ‘pressing down’ when holding a glue gun as an Archetype of collective unconscious behavior, which belongs to Product A-glue gun's product system. This is shown in Figure 4.13.

In the first step, the designer identifies the signified of ‘pressing’ as ‘press can/to flow liquid glue.’ After that, based on the similarity of the signified, the designer searches for a product B that carries a similar signified. The designer thinks of the insulin injection pen used by diabetics (Figure 4.14), which also has the signified ‘press can/to flow out liquid.’ Therefore, in step three, Object B is the product structure of the insulin pen that enables ‘press can/to flow out liquid.’ When users use this insulin pen, the protective cap of the pen tip presses against the skin, exposing the needle and allowing liquid to flow out through an internal spring mechanism. This structure, as a product feature, embodies the signified ‘press can/to flow out liquid.’ Consequently, the designer replaces Object A in the product A system with this structure as Object B, integrating it as part of the product A system.

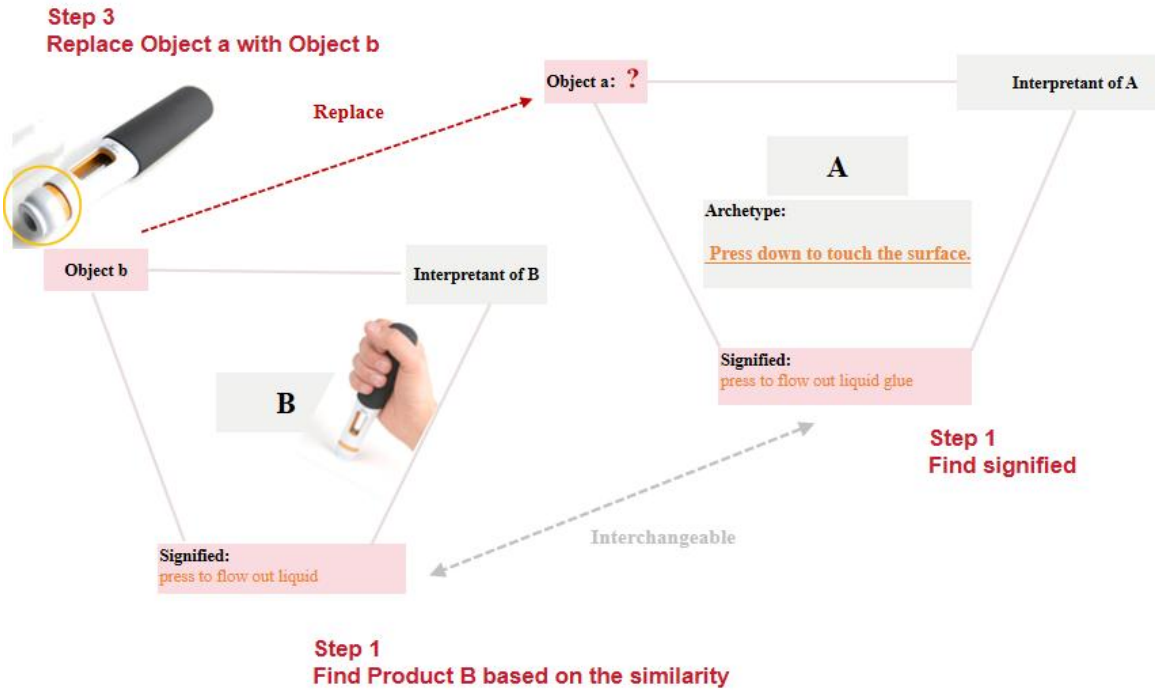


Figure 4.13 Using Metonymy formula to Apply Unconscious Behavior 2

Figure 4.14 Insulin Injection Designed by Smart Design

In the designer's preliminary design concept, by replacing the front structure from the insulin injection pen, the user only needs to press down on the glue gun as if they were using a pen to dispense glue. To assess whether this innovation aligns with the user's unconscious behavior and basic process, the designer incorporates the design concept into the scenario where the user uses the glue gun on a flat surface as shown in Figure 4.15. Finally, the designer confirms that

replacing the front end of the glue gun with the insulin injection pen's front structure is feasible and will not interrupt the existing unconscious action.

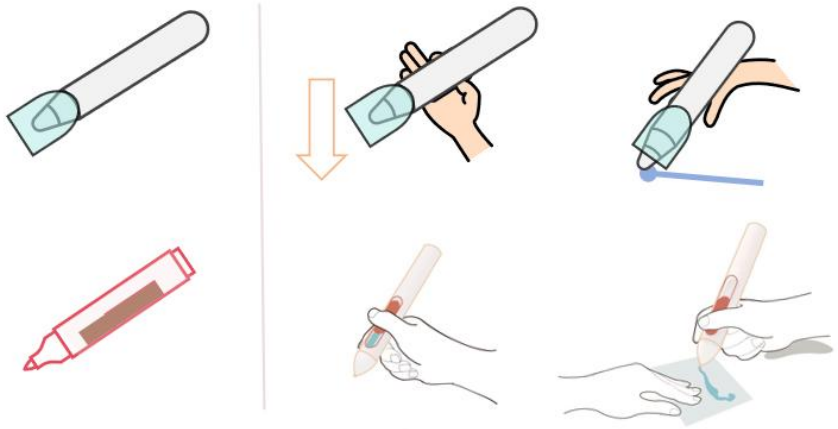


Figure 4.15 Substitute the design concept into the interaction journey to do Feasibility Assessment

4.4 Design Delivery

The designer has proposed feasible design points in the previous step. In design delivery, the designer improves the scheme through sketch and 3D modeling, and makes a prototype using 3D printing to test the rationality of the design.

4.4.1 Design Concept 1

The designer use sketches to further develop design concept 1 (Figure 4.16). The main design point of this solution is to replace the slider of the existing product with a trigger. While developing this concept, the designer also referred to the information of Project Research and added advanced function and ergonomic design to the product.

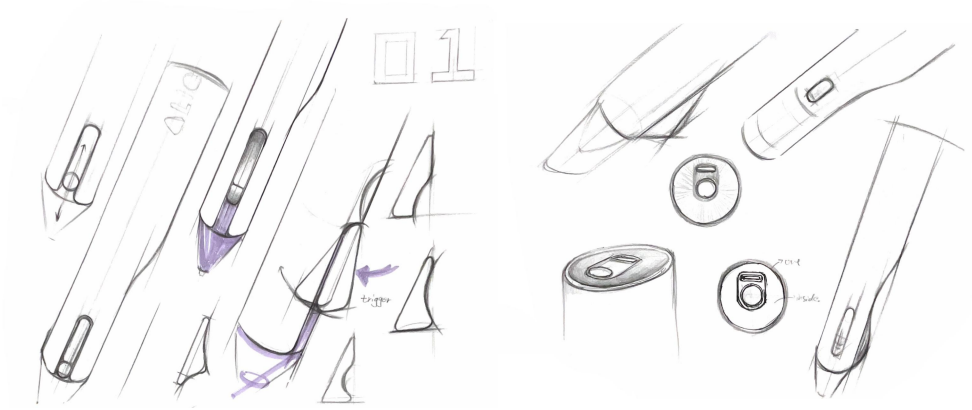


Figure 4.16 Design Concept Sketches

A brief usage process (Figure 4.17) is created to present user's gesture in each step and to show how unconscious behavior can be applied in interaction without imposing a burden on the user. The designer designs the switch button near the trigger，so no more change of gesture will be need.

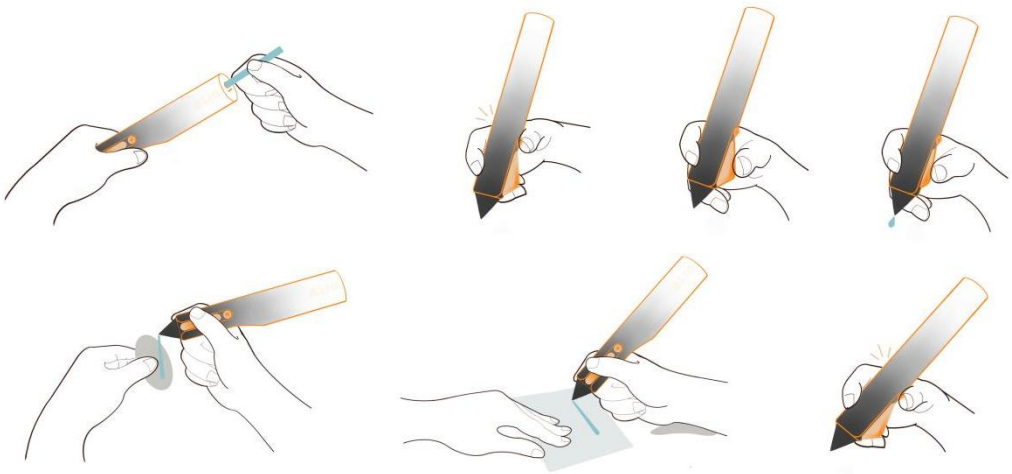


Figure 4.17 Usage Process of Design Concept 1

Figures 4.18 shows the first final design application of Design Route B. A CAD model is built to visualize the application.

Figure 4.18 CAD Model and Rendering

Prototyping is the most significant way to test the usability of a product. Figure 4.19 shows the prototype of the first application， which displays the product innovation and well-designed ergonomic form.

Figure 4.19 Prototype of the first application

4.4.2 Design Concept 2

Sketches are created to deeply develop the detail of Design Concept 2 (Figure 4.20). In this concept, the designer replaces the front spring structure of the insulin injection pen with that of the glue gun. The designer further explores the internal structure and advanced features,

incorporating sensors controlled by an Intelligent Chip Control into the product. When the user presses down on the tip, they can control the amount and speed of the glue flow based on the pressure applied.

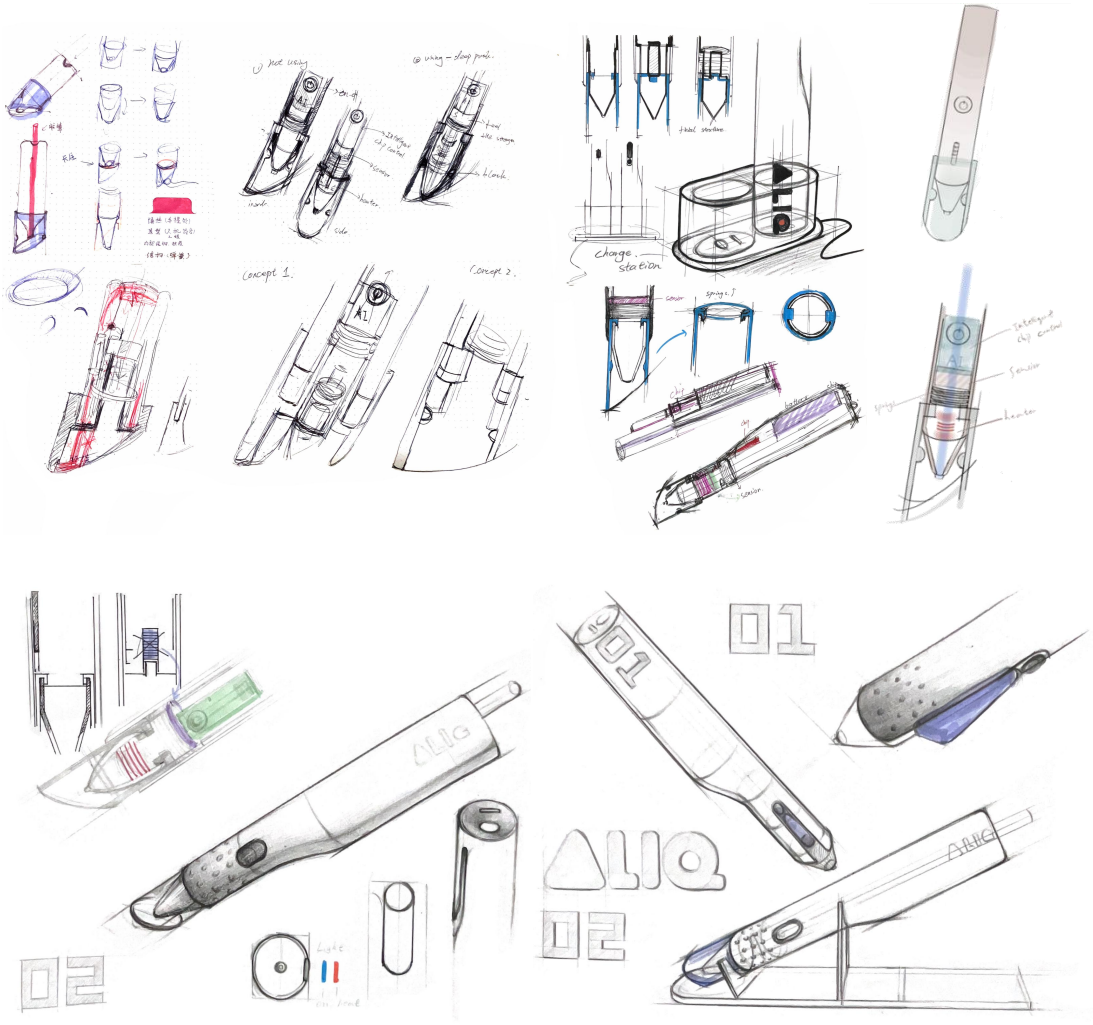


Figure 4.20 Design Concept Sketches

To evaluate whether the design aligns with the user's unconscious behaviors and usage flow, a usage process is created to illustrate the interaction in each step (Figure 4.21).

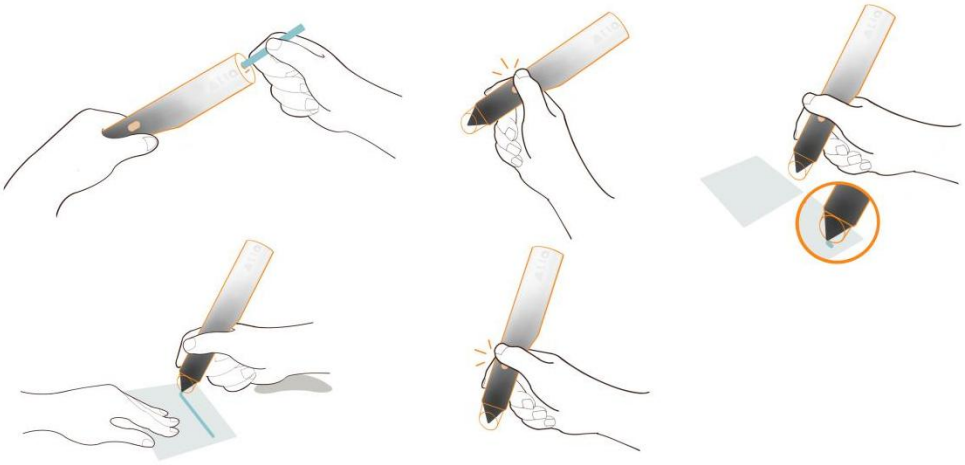


Figure 4.21 Usage Process of Design Concept 2

Figures 4.22 shows the CAD model and rendering of the second application of Design Route B.

Figure 4.22 CAD Model and Rendering

As shown in figure 4.23, a prototype is made to validate and demonstrate the usability of this application. The application displays a smooth and continuous usage process. By utilizing unconscious behaviors, this application achieves a very creative product innovation.

Figure 4.23 Prototype of the Second Application

Chapter 5: Conclusion

The purpose of this study is to develop a design guideline to apply user's unconscious behavior to product innovation. This thesis adopts an inductive approach, deriving a theoretical design guideline through a literature review. Chapter 2: The literature review covers the origins and relevant theories of unconscious behavior, including studies of the collective unconscious in psychoanalysis and consciousness in ecological psychology. It also includes the definition, importance, and design process of product interaction design. Additionally, Chapter 2 provides a comprehensive review of the foundational theories of *Without Thought Design*. It attempts to analyze these theories through the lens of semiotics and rhetoric. Moreover, Chapter 2 analyzes three types of *Without Thought Design*, which apply users' unconscious behavior in product interaction in different ways. This thesis refines the two types present in *Without Thought Design*—Objective Sketching and Found Object—into one design direction and three rhetorical types. Based on existing theories, research, and analysis, this thesis proposes three design routes for guidelines in Chapter 3.

Chapter 3 presents the design guideline, highlighting the four key steps which cover Project Research, Transcribe and Analyze User’s Unconscious Behavior, Apply Design Route, and Design Delivery. It explains how to record and analyze users' unconscious behaviors, determine design routes, and innovate interaction design through these routes, ultimately achieving innovation in user interaction experience. The design guideline is based on the process of product interaction design. Based on the collection and analysis of users' unconscious behaviors, the three design routes can be applied. The aim is to innovate products from three perspectives: product affordance, interaction process, and emotional value. The design guideline includes a

complete design flow, and the design tools needed at each step. Designers can choose different tools according to the selected design route.

Chapter 4 applies the theoretical design guideline to a practical design project demonstrating the application process using one design route. It applies two different types of users' unconscious behaviors and ultimately presents two design applications. By using this guideline, designers can not only address existing problems but also provide a smoother, burden-free user experience while innovating the product.

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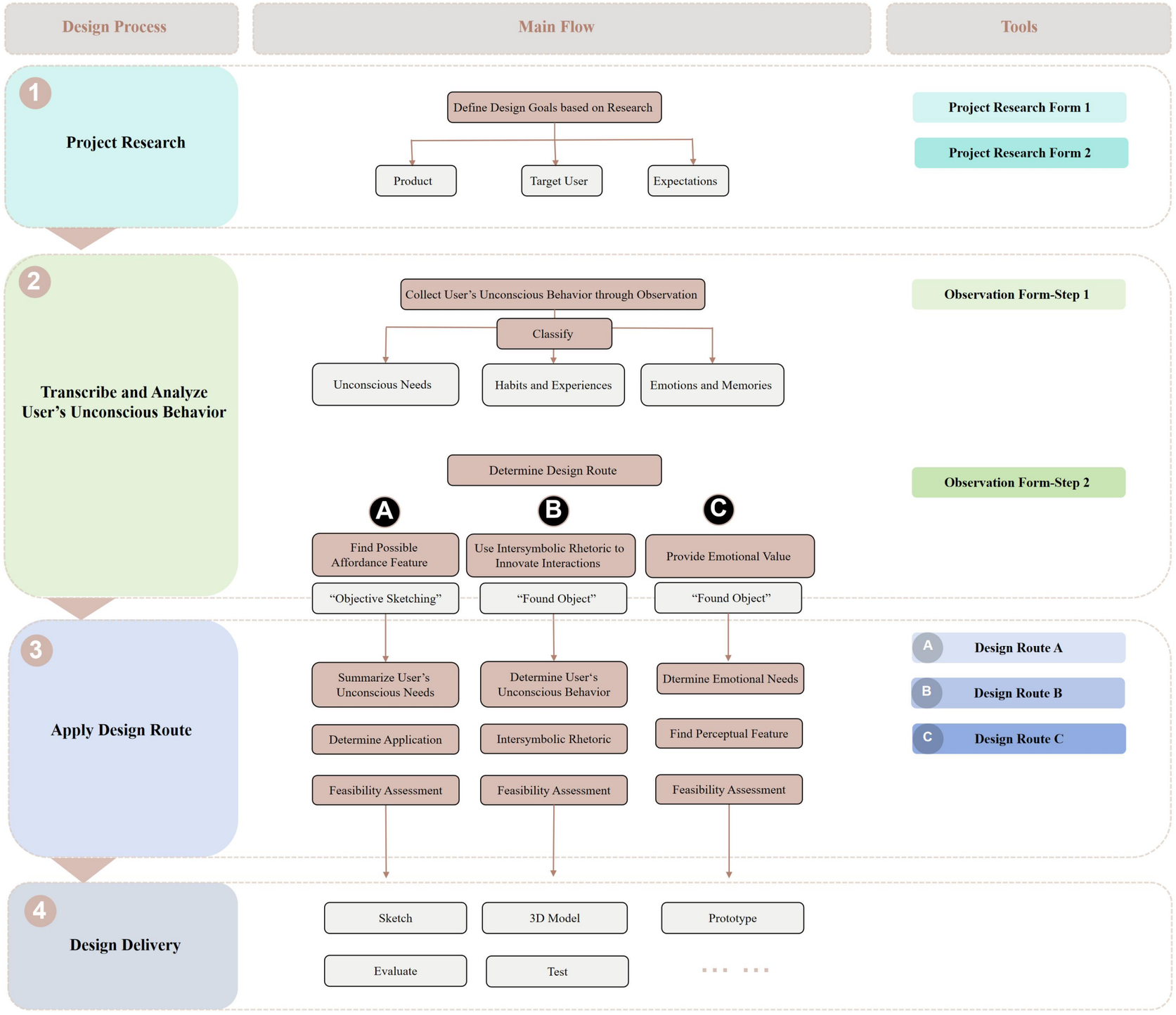
APPENDICES

Appendix 1: Guidelines Flow



Appendix 2: Project Research Form 1

1 Project Research Form 1

Project Name: _____ **Form Number:**_____ **Date:**___/___/ * Designers can use multiple forms.

Step 1 Product Research

01 Background

02 Competitor Analysis

Product Name/ Brand	Price	Basic functions/Advanced features	Selling points / Innovations	Advantage & Disadvantage	Customer Feedback

Step 2 Target User Research

01 Persona

Image

Name:

Age:

Career:

Wages:

Description:

Expectation:

Image

Name:

Age:

Career:

Wages:

Description:

Expectation:

02 Interaction Journey

Stages								
Experience Process								
Images								
Touch Point								
Emotions								
Problems								
Design Opportunities								

Appendix 3: Project Research Form 2

1 Project Research Form 2

Project Name: _____ **Form Number:**_____ **Date:**___/___/___ * Designers can use multiple forms.

Step 2 Target User Research

03 User Interview

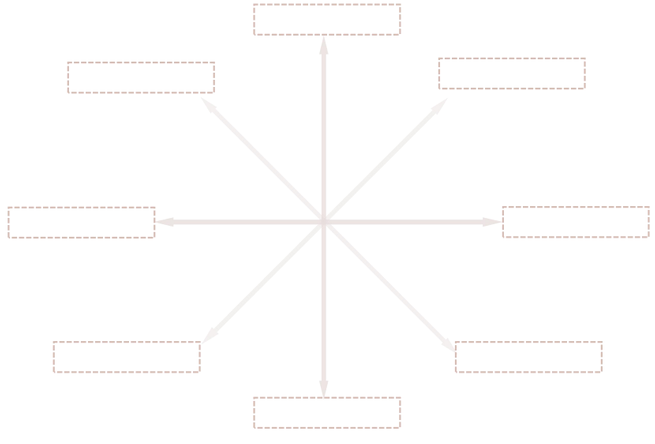
Steps to conduct an interview	Interview Structure
1. Define the Purpose	**Part 1: Demographic information** Introduction：Explain the purpose of the interview Background：About the background of interviewee
2. Identify the Target Audience	
3. Develop a Question Guide	**Part 2：Main Questions about the Project** Dive into the main topics you want to explore.Break down the research questions and express them in understandable language to ensure that the questions are specific and related to what you hope to achieve， and avoid confusing participants. After a participants say something, follow up with probing questions to uncover the unconscious needs.
4. Structure the Interview	**When a participant says something like:** I want I need I think
5. Choose the Interview Format: In-Person, Written., Remote (e.g., via Zoom or phone).	**Ask them probing questions:** How so? / How did you feel about that? In what way? / Can you give me an example? How do you know... / What makes you feel that way? What do you mean by... / What are some of your reasons for...
6. Prepare the Logistics	
7. Conduct the Interview	**Part 3：Recommendation** Designs should ask about： 1 Let the participants evaluate the whole product, and the difficulties in using it. 2. Make suggestions based on the discussion. 3. Explore what participants perceived as possible improvements.
8. Follow-Up	

Participant Name: **Age:** **Career:** **Time:**

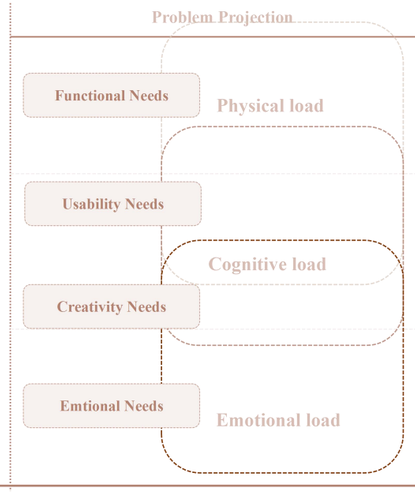
	Questions	Answers
1		
2		
3		
4		
5		
6		
7		
8		

Step 3 Design Expectations

01 Cross-Axis of Expected Products Features / Spider Chart



02 Research Summary



Design Expectation/ Preliminary Product Definition

Appendix 4: Observation Form

2 **Transcribe and Analyze User's Unconscious Behavior - Observation Form**

Project Name: _____ **Form Number:**_____ **Date:**__/__/__ * Designers can use multiple forms.

Step 1 **Collect User's Unconscious Behavior**

When the designer start an observation, or watching recording vedioes, fill in all the user's actions here, try to include all details, such as usage scenarios, specific gestures, direction of action, tools used, error actions，emotional changes，etc.

Analyze the user's unconscious behavior from all actions；If it does not exit, leave it blank.

Analyze the user's motivation and needs after his behavior，including physical，emotional，cognitive needs.

Step 2 **Determine Design Route**

Designers should make informed decisions on the most suitable design route based on the results of previous research (From 1)and the analysis of users' unconscious behavior. Designers can follow these selection principles for choosing the appropriate design Route:

- If the product design aims to meet the user's unconscious needs, mainly to adding new usage , Method A should be prioritized.
- If it is to satisfy the user's requirements for product usability, Method B should take precedence.
- If the design aims to fulfill the user's emotional needs towards the product, Method C is recommended.

Leave ✓ for YES, leave it blank for not choosing.
See Figure 3 behind for details.

Scenarios	Step	All Actions		Unconscious Behavior	Motivation and Needs Analyze	Design Route		
						A	B	C

NOTE: Designers can take notes here during the process.

Appendix 5: Design Route A Application Form

3 Design Route Ⓐ - Find Possible Affordance

Project Name: _____ **Form Number:**_____ **Date:**____/____/

* Designers can use multiple forms.

Step 1 Summarize User 's Unconscious Needs - Functional and Usability needs

Designers should filter out the users' unconscious functional and usability needs based on the motivation and needs analysis summarized in the Observation Form.

Designers should fill in this section at the corresponding positions of the behaviors in the Observation Form . This step is to maintain the continuity of these behaviors, facilitating the subsequent Feasibility Assessment.

Analyze the user's unconscious behavior from all actions; If it does not exit, leave it blank.

Analyze the user's motivation and needs after his behavior, including physical, emotional, cognitive needs.

Step 2 Determination

Designers need to determine one or more design opportunity based on previous research findings and subjective intentions to continue the application.

For example, they can observe if there are related problems in the previously research, whether the design opportunity can effectively address these issues, etc.

Step 3 Feasibility Assessment

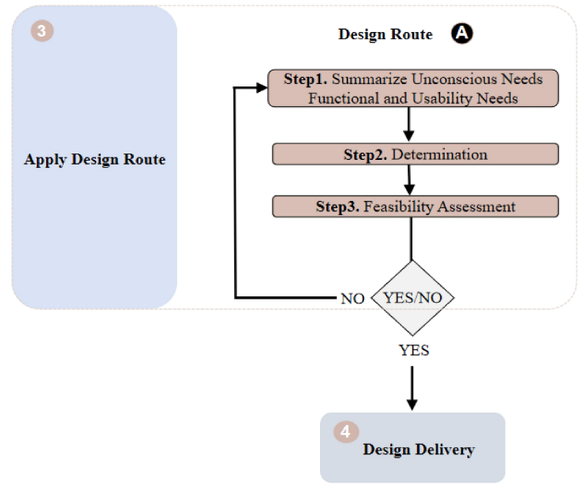
The application of Design Route-A is to increase the affordance features of the product according to the user's needs, without interrupting the user's original continuous behavior and without affecting the user's using process at the same time. Therefore, after selecting the design point, designers should assess whether the application of the design point is in line with the basic concept of 'objective sketching' in unconscious design according to the following aspects .

After the feasibility assessment, the designer needs to choose the following path according to application flow.

Scenarios	Step	Functional and Usability Needs	Design Point	Checkbox

- Determine whether the design points contradict each other or overlap with other functions.
- Validate whether it can solve the objective problems of the product and meet the user's needs according to the previous research section.
- Substitute the design points into the interaction journey or unconscious behavior observation form, and observe whether the application of the design points will interrupt the coherence of the user's usage.
- Whether the addition of new design points causes disturbance to users, such as physical load cognitive load emotional load.
- Place the design point in a specific use scenario or multiple use scenarios where the unconscious behavior occurs, and push to see if it meets the set constraints.
- Ask users if they can easily understand the design point or do another observation to validate.
- The added feature needs to comply with the specific product specifications and standards, e.g. check the ADA guideline that corresponds to the product.

Design Route A Application flow



Appendix 6: Design Route B Application Form

3 Design Route Ⓑ - Use Intersymbolic Rhetoric to Innovate Interactions . **Project Name:** _____ **Form Number:**_____ **Date:**___/___/ * Designers can use multiple forms.

Step 1 Determine User's Unconscious behavior

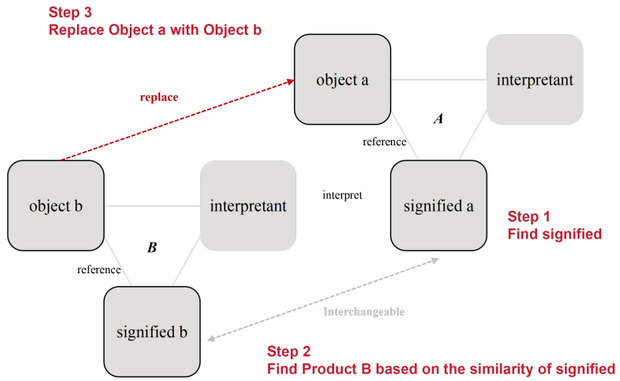
Designers should fill out the selection of unconscious behaviors ,and analyz the product structure related to the unconscious behaviors listed in the Observation form for Design Route-B, and assess whether there are problems that need to be solved based on the summary of the project research. Based on all the information, designers need to prioritize the behaviors, and finally determine one unconscious behavior to apply.

Unconsious Behavior	Related Product Feature	Related Problems	Prioritize

Step 2 Intersymbolic Rhetoric - Metonymy

In this step, the designer uses metonymy from rhetoric. Based on the similarity of the behavioral text meaning between products A and B, the designer identifies Product B and then substitutes the textual carrier object.

1. See the unconscious behavior as a symbolic text carried by the product, and identify its signified. The signified refers to the concept or meaning expressed by a symbol, which can be understood as the nature and meaning of the behavior.
2. Find Product B that carries a similar signified, and identify the object that acts as the carrier of this signified in Product B (Figure 2.14). In this step, the designer needs to use their personal and design experience to find Product B, with the signified being the essential condition for identifying Product B.
3. Replace the object that acts as the carrier of the signified in Product B for the original object in Product A.
4. Derive the design scheme for Product A based on the replaced object. The schemes derived from the same unconscious behavior should not be used together to avoid contradictions.



Step 1 Find signified

The signifiant of user's unconscious behavior _____

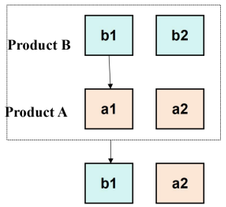
The nature，aim and meaning of the behavior.

Step 2 Find Product B based on the similarity of signifiant

The signifiant can be interchangeable

Step 3 Replace Object a with Object b

Replace the product feature fron product B to product A.
Object to object

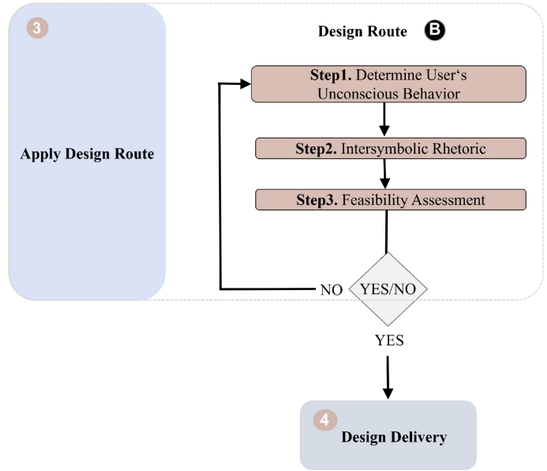


Step 3 Feasibility Assessment

This step aims to evaluate the feasibility of the concept. The application of Design Route-B involves substituting part of the interaction from Product B into Product A without altering the user's unconscious behavior. This approach aims to improve or innovate the interaction while potentially solving some of the product's issues. At this stage, designers can determine the reasonableness of the final concept based on the following information

- Substitute the design points into the interaction journey or unconscious behavior observation form, and observe whether the application of the design points will interrupt the coherence of using process.
- Whether the design points causes burden to users, such as physical load cognitive load emotional load (Sweller, 1988).
- Place the design point in a specific use scenario or multiple use scenarios where the unconscious behavior occurs, and deduce to see if it meets the set constraints.
- Ask users if they can easily understand the design point or do another observation to validate.
- The added feature needs to comply with the specific product specifications and standards, e.g. check the ADA guideline that corresponds to the product.

Design Route B Application Flow



Appendix 7: Design Route C Application Form

3 Design Route © - Provide Emotional Value

Project Name: _____ **Form Number:**_____ **Date:**___/___/

* Designers can use multiple forms.

Step 1 Define Users' Emotional Needs

Designers should fill out the selection of unconscious behaviors ,and analyz the product structure related to the unconscious behaviors listed in the Observation form for Design Route-B, and assess whether there are problems that need to be solved based on the summary of the project research. Based on all the information, designers need to prioritize the behaviors, and finally determine one unconscious behavior to apply.

Unconsious Behavior	Related Product Feature	Related Problems	Prioritize

Collect Emotional Terms - Build Emotion Sentences

Designers need to build Emotion Sentences to uncover the true emotional needs behind users' unconscious behaviors. The content of the entence should include the way the user receives information, the product information received, the emotional purpose of receiving the information, and the feedback the designer needs to provide.

User through (action) (product/feature) **to** (emotional issue)**. Designer needs to provide** (What emotional value) **through expected product.**

User through_____**to**_____**. Designer needs to provide through expected product.**

For example, the following sentence:

User through touching the surface material of the arm sling to alleviate anxiety.

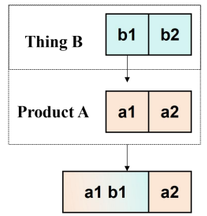
Designer needs to provide comfort through the expected product.

Step 2 Find Perceptual Features

When using implied metaphor to explain the unconscious design, Thing B integrated its carrying emotional value and meaning into product A, making up for the lack of emotional value of product A. This step is to find Thing B that carries the same information.

The greater the gap between thing B and product A in the cognitive range, the product will be more innovative. Designers need to perceive the possible thing B.This direction is just a way of thinking for designers to reference.

Implied metaphor Integrated emotional value and meaning from Thing B



Step 1 Find Thing B

For example, the following sentence:

Product A User through **touching the surface material of the arm sling** to **alleviate anxiety**. Designer needs to provide comfort through the expected product

Thing B Thing B should satisfy **touching certain appearance material** can **relieve anxiety.**

Step 2 Find perceptual feature according to related product feature

Visual Features	Auditory Features
● Color : The color combinations and tones of the product. ● Shape: The design and form of the product. ● Size:The dimensions and proportions of the product. ● Texture : The visual representation of the surface quality. ● Pattern : The graphics or patterns used in the design.	● Sound: The noises produced when using the product, such as clicks or alerts. ● Tone: The pitch and timbre of the sounds. ● Volume: The loudness of the sounds.

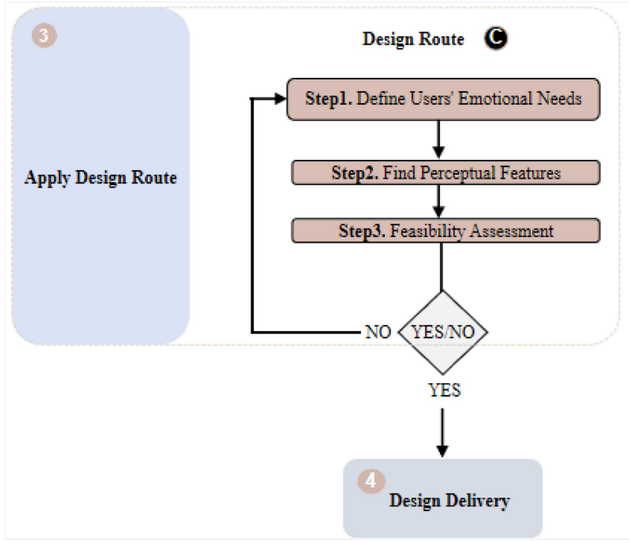
Tactile Features	Gustatory Features
● Material Texture: The feel of the product's surface, like smoothness or roughness. ● Temperature: The warmth or coolness felt when touching the product. ● Weight:The perceived heaviness of the product.	● Taste:The taste characteristics related to food or oral products.
	Olfactory Features
	● Scent : The smells emitted by the product, such as fragrances from perfumes or air fresheners.

Step 3 Feasibility Assessment

This step aims to evaluate the feasibility of the concept. The application of Design Route-C aims to integrate perceptual features from Thing B to Product A, carrying emotional value into product A to form emotional value. At this stage, designers can determine the reasonableness of the final concept based on the following information

- Whether the user feels more satisfying when they using the product in a natural and relaxed environment.
- Substitute the design points into the interaction journey or unconscious behavior observation form, and observe whether the application of the design points will interrupt the coherence of using process.
- Whether the design points causes burden to users, such as physical load cognitive load emotional load (Sweller, 1988).
- Place the design point in a specific use scenario or multiple use scenarios where the unconscious behavior occurs, and deduce to see if it meets the set constraints.
- Ask users if they can easily understand the design point or do another observation to validate.
- The added feature needs to comply with the specific product specifications and standards, e.g. check the ADA guideline that corresponds to the product.

Design Route C Application Flow



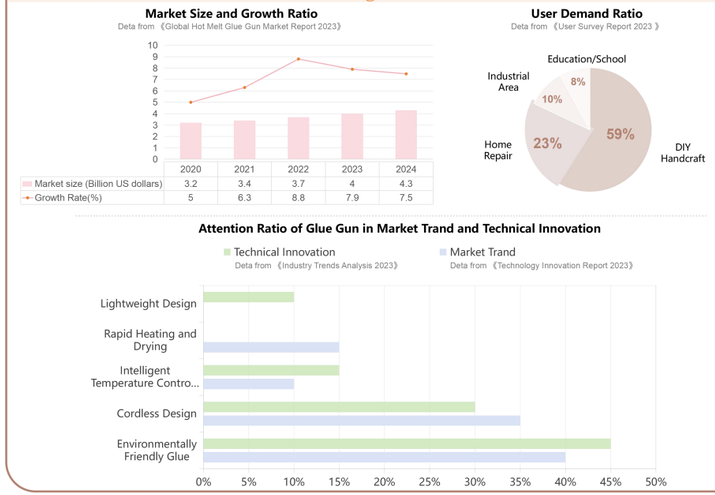
Appendix 8: Project Research Form 1 Applied to Glue Gun

1 Project Research Form 1

Project Name: Glue Gun **Form Number:** 1 **Date:** 06 / 13 / 24 * Designers can use multiple forms.

Step 1 Product Research

01 Background



02 Competitor Analysis

Product Name/ Brand	Price	Basic functions/Advanced features	Selling points / Innovations	Advantage & Disadvantage	Custome Feedback
 **No.1** Hot Glue Gun Amazon-Bukicho	$9.99	Traditional glue gun. Heats up in 1.5-3 minutes LED indicator light Removable stand holds the glue gun stable Requires power connection to use	Small size Good ergonomic design Strong Adhesiveness Easy to toggle the On/Off switch	The ergonomic rubber handle and trigger offer a comfortable grip, portable and lightweight design can help to use it easily and reduced fatigue. Limit scenarios,Hard to control the heated glue.	Need to turn off in advance to stop melting the glue.Limit protection· 
 **No.2** Full Size Cordless Glue Gun	$68.99	Temp control(212-392°F). LCD Digital Display Dripless & Anti-Scald Nozzles Cordless. 1 Lithium Ion batteries required Heats up in 2 minutes	Accurate Temp Adjust Not only for DIY, crafts and home repairs but also heavy-duty construction or woodworking projects.	Carry battery, convenient for projects requiring frequent movements or quick finish. Work for Limit Battery, not Interchangeable with Other Brands.	Not friendly for entry-level user. A little expensive. Heavy for longtime-working.
 **No.3** Cordless Glue Pan Amazon-Huepar	$29.97	Cordless powered by LI-ION battery Intelligent Chip Control, an automatic glue stick feeding system,turn off automatically after 30 seconds of inactivity Heat-up in 10 seconds, LED indicator light	Multipurpose Cordless & Ergonomic Design Intelligent Chip Control Rapid Heating USB Rechargeable Li-ion Battery	Smart system.Smiple interaction,Friendy for entry-level user. Portable.Easy and comfortable to hold. Multiple scenarios Limit protection. Limit speed.	“Only one speed,On a normal glue gun you can pull the trigger harder to get a thicker bead by putting glue through faster.”
 **No.4** Cordless Glue Pan Amazon-Doinow	$19.9	Cordless powered by LI-ION battery Intelligent Chip Control, It powers off Automatically after 100s. Heat-up in 10 seconds. LED indicator light	Ergonomic Innovation Design USB-C rechargeable design Insulated structure Rapid Heating	The pen-shaped design is easy to hold and control, providing a comfortable grip feeling. Limit protection. Limit speed.	Glue stick outside is very easy to be bent when holding it, which sometims requires manual adjustment to prevent clogging.

Step 2 Target User Research

01 Persona

Name: Nina M
Age: 28
Career: craftsman
Wages: 50K

Expectation:

- Comfort
- Portable
- Efficient
- Safe
- Easy to operate
- Save Strength

Description:

Due to professional needs, she usually use hand-held tools for a long time.She has high requirements for the comfort of hand-held tools and do not like to operate tools that are too complicated.

Name: Josh T
Age: 33
Career: local artist
Wages: 29K

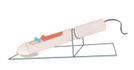
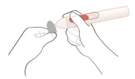
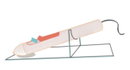
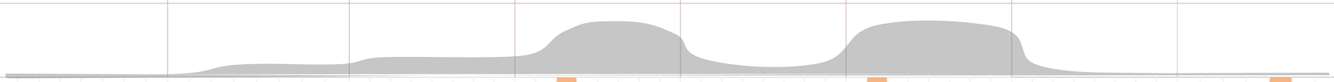
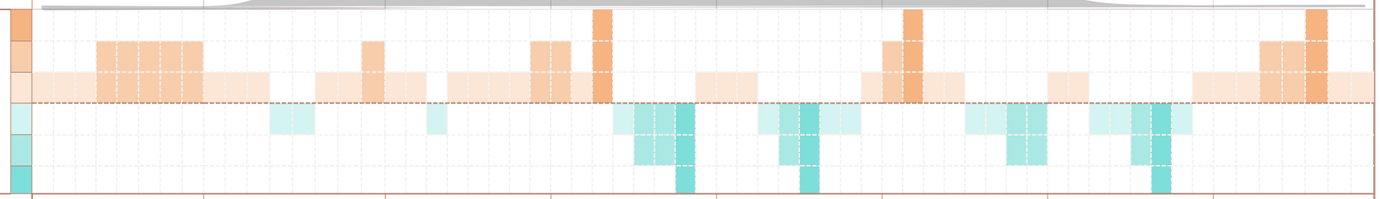
Expectation:

- Comfort
- Portable
- Efficient
- Safe
- Easy to operate
- Save Strength

Description:

He often explores different art forms on canvas, gluing a variety of materials, requiring extensive use of glue on flat surfaces.He is entry-level in DIY area.

02 Interaction Journey

Stages	Prepare	Use					Finish
Experience Process	**Charge**	**Load a glue stick**	**Turn on**	**Use on a plat surface**	**Load a glue stick**	**Use on a 3D product**	**Turn off**	**Charge**
Images								
Hand Strength Level								
Emotions								
Problems	Sometimes can not see the charging light is on the bottom.	Glue stick might be too short.	Glue stick might fall down when right hand changes position.	The thumb needs to be exerted all the time. Very hard to control the glue out on the surface, can not draw even line.Occasionally been burned by the tip of it.	Glue stick is too short, need to reload every 1 mintue.	Gradually losing control of thumb strength, the direction of the slider makes the thumb very tired. Occasionally been burned by the tip of it.	The heated glue is still flowing out when turning off the product.	Sometimes can not see the charging light is on the bottom.
Design Suggestions	Change the position of charging light.	Change the structure of loading part.	Change the structure of loading part. Change the position of switch.	Redesign the tip to control the heated glue easily, and something can protect fingers from being burned.	Change the structure of loading part.	Redesign the slider to reduce the physical load on the thumb.	Adding some protection.	Change the position of charging light.

Appendix 9: Project Research Form 2 Applied to Glue Gun

1 Project Research Form 2

Project Name: Glue Gun **Form Number:** 1 **Date:** 06 / 13 /24 * Designers can use multiple forms.

Step 2 Target User Research

03 User Interview

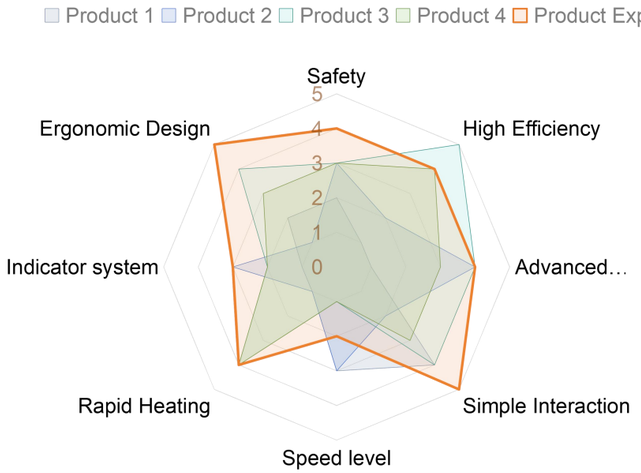
Steps to conduct an interview	Interview Structure
1. Define the Purpose Uncover Unconscious Needs Find exicting painpoint, Ask suggestions	**Part 1: Demographic information** Introduction：Explain the purpose of the interview Background：About the background of interviewee
2. Identify the Target Audience Entry-level user Professonal user	**Part 2：Main Questions about the Project** Dive into the main topics you want to explore.Break down the research questions and express them in understandable language to ensure that the questions are specific and related to what you hope to achieve ， and avoid confusing participants. After a participants say something, follow up with probing questions to uncover the unconscious needs.
3. Develop a Question Guide Questions must includs the first time they use.Briefly ask their feelings and possible failure/error.	**When a participant says something like:** I want I need I think **Ask them probing questions:** How so? / How did you feel about that? In what way? / Can you give me an example? How do you know... / What makes you feel that way? What do you mean by... / What are some of your reasons for...
4. Structure the Interview	
5. Choose the Interview Format: In-Person, Written., Remote (e.g., via Zoom or phone).	
6. Prepare the Logistics	
7. Conduct the Interview	**Part 3：Recommendation** Designs should ask about： 1 Let the participants evaluate the whole product, and the difficulties in using it. 2. Make suggestions based on the discussion. 3. Explore what participants perceived as possible improvements.
8. Follow-Up	

Participant Name: Sherry H **Age:** 40 **Career:** Freelance work (Making Handcrafts) **Time:** 4-4:15pm

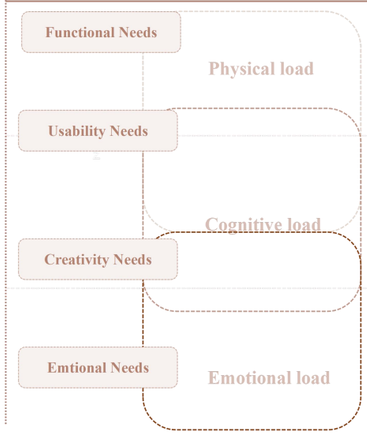
		Questions	Answers
1	P1	Can you tell me about yourself ? your name, age, current career?	Yes, sure, My name is Sherry Hu, and I am 40 years old, I have been doing freelance work for almost 4 years. I do handcrafts at home and sell them online.
2		Are you Familiar with glue gun? How often do you use it? In what scenarios will you use it?	Yes I am, I use it from the very begining of my career. I use it to glue a lot of different material on my artpiece.I am using it everyday. I also use it when I need to do some decoration in my house.
3		Have you ever used a glue pen, a glue gun in pan-shape?	Yes I have. But I dont use it too often.
4		If yes, can you discribe the first time you using this? and how do you feel? / If not, whet is your most familiar type of glue gun? how do you feel when you using it?	I think when the first time I am using it, I am truely surprised by the shape, because it is more easiler to hold than the traditional glue gun.
5		Why do you feel that way?	Because the one I used before, I mean the traditional one, it is a gun-shape, it is not that easy tto control if I want to do something on a single surface.
6	P2	In addition to what you just mentioned, do you think there are any part makes you feel easy to use? (or any difficulties when you use them?)	I think I just mentioned I don't use it too often, that is because the glue pan I use, it has to be reloaded the glue stick every 2 minutes, and when I reload , the heated glue is still melting. It is easy to grab, but not easy when I using it for a longtime work.
7		Besides this, can you describe at least one advantage/disadvantage it has, but other type of glue guns don't? Can you give me more detail?	Yes, sure. I think the most biggest advantage it has is that it is designed Cordless, which means I dont have to connect it to the power supply everytime I use. I think most of the other glue gun still need to be connected. And the other disadvantage about it would be the slider part , it always takes me a lot of strength to use.
8		Which of the following do you think is most important to you? Safety, portability, functionality, comfort, durability. Can you rank them in order of importance to you? What makes you feel that way?	It think the safety must be the first, then functionality, comfort, durability, the last one could be portability, cause I do most of the work at home.
9	P3	If there is one thing you dislike the most about him, what would you suggest to improve it?	The most disappointed point for me will be the loading part I mentioned. and Maybe the slider part should change to another position, so the glue stick I put in can be long enought.

Step 3 Design Expectations

01 Cross-Axis of Expected Products Features / Spider Chart



02 Research Summary



Design Expectation/ Preliminary Product Definition

- **Cordless - powered by LI-ION battery**
- **Protection from the tip - Adding lid or stand**
- **Multiple Speed level - Intelligent Chip Control**
- **High Efficiency - Change the loading part- Use competitor No.3 as refernece**
- **Easy to control the heated glue in different scenariosio**
- **- Plane and solid surface - Use competitor No.1 ， the interaction of the trigger as reference**
- **Easy to Grab or Hold - Ergonomic Design- Use competitor No.3 No.4 as reference**
- **Entry-level friendly - Make the interaction more easier to understand - Less buttom**
- **- Clear indicator light (not in the bottom)**

Users don't have many emtional needs for this product

Appendix 10: Observation Form Applied to Glue Gun

2 Transcribe and Analyze User's Unconscious Behavior - Observation Form

Project Name: Glue gun **Form Number:** 1 **Date:** 06 / 13 / 24 * Designers can use multiple forms.

Step 1 Collect User's Unconscious Behavior

When the designer start an observation, or watching recording vedioes, fill in all the user's actions here, try to include all details, such as usage scenarios, specific gestures, direction of action, tools used, error actions, emotional changes, etc.

Analyze the user's unconscious behavior from all actions; If it does not exit, leave it blank.

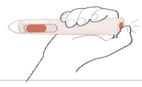
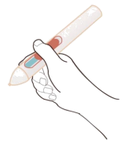
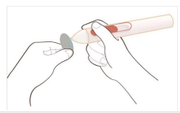
Analyze the user's motivation and needs after his behavior, including physical, emotional, cognitive needs.

Step 2 Determine Design Route

Designers should make informed decisions on the most suitable design route based on the results of previous research (From 1)and the analysis of users' unconscious behavior. Designers can follow these selection principles for choosing the appropriate design Route:

- If it aims to meet the user's unconscious needs, mainly to adding new function , Method A should be prioritized.
- If it is to satisfy the user's requirements for product usability, Method B should take precedence.
- If the design aims to fulfill the user's emotional needs towards the product, Method C is recommended.

Leave ✓ for YES, leave it blank when not choosing.

Scenarios	Step	All Actions		Unconscious Behavior	Motivation and Needs Analyze	Design Route		
						A	B	C
Prepare	1		Using right hand to pickup the glue gun.	Right hand	Habit		✓	
	2		Right hand holding the product. Left hand insert th the glue stick into the loading point.			✓		
Turn on	3		Hold the product with his right hand and turn on the switch with his thumb.				✓	
	4		Hold the glue gun with his right hand and place his thumb on the slider.	Holding the glue gun like holding a pen. Hold with his thumb and index finger.	Habit & Experience		✓	
			Moving his thumb from up to down , push down the slider until the glue is beening heated and ready to use.				✓	
On flat surface	5		After the glue emerges from the tip of the pen, hold the pen with his right hand and use it downward.	Press down the glue gun.	Draw the liquid glue on the paper		✓	
			The tip of the glue pen slides on the paper , the user attempts to draw an even line, but failed.	Press down and slide	Draw the liquid glue on the paper		✓	
Prepare	6		Right hand holding the product. Left hand insert the glue stick to reload.			✓		
	7		Moving his thumb from up to down , push down the slider until the glue is beening heated and ready to use. It was a bit of a struggle to keep his thumb strained and keep pushing the slider.	Holding the glue gun like holding a pen.Using thumb to active the heating funcation.	To activate the heating function.		✓	
On 3D product	8		The user tries to glue together 2 pieces of 3D products, but once the object is above a certain height, the hand loses its support point, and it is difficult for the thumb to exert force.	Holding the glue gun like holding a pen.Using thumb to active the heating funcation.	To activate the heating function.	✓		
Turn off	9		Hold the product with his right hand and turn off the switch with his thumb. Heated glue continues to flow out. User don't know how to deal with it.			✓		

Appendix 11: Design Route B Application Form Applied to Glue Gun

3 Design Route Ⓑ - Use Intersymbolic Rhetoric to Innovate Interactions .

Project Name: Glue gun Form Number: 1 Date: 06 / 13 / 24 * Designers can use multiple forms.

Step 1 Determine User's Unconscious behavior

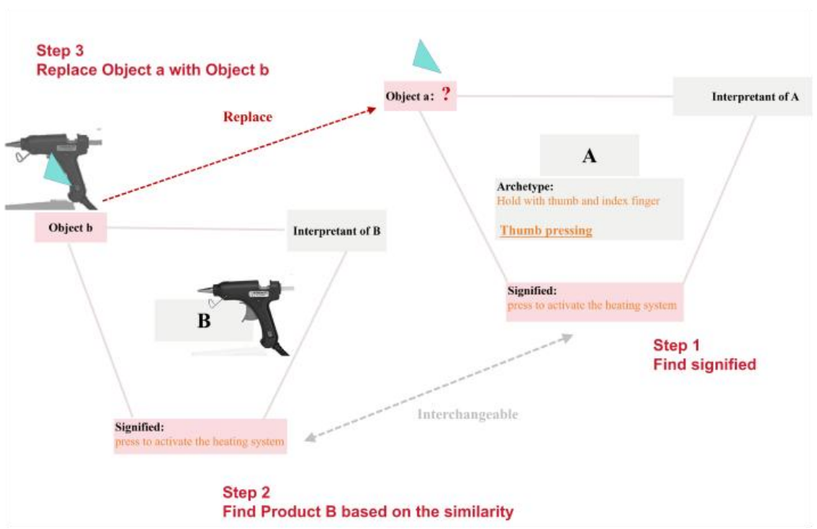
Designers should fill out the selection of unconscious behaviors ,and analyze the product structure related to the unconscious behaviors listed in the Observation form for Design Route-B, and assess whether there are problems that need to be solved based on the summary of the project research. Based on all the information, designers need to prioritize the behaviors, and finally determine one unconscious behavior to apply.

Unconsious Behavior	Related Product Feature	Related Problems	Prioritize
Hold the product with his thumb and index finger 	The shape of pan, the silder 	The silder is hard to push	2
Put thumb on the slide to activate the heating system 	The shape of pen, the silder loading system 	Need reload the glue stick for multiple times. Can not control the glue speed	1
Press down the glue gun to flow liquid glue 	The tip of glue gun Heating system 	Can not control the glue speed Not safe enough	3
Press down the glue gun and slide to flow liquid glue 	The tip of glue gun Heating system 	Can not control the glue speed Not safe enough	4

Step 2 Intersymbolic Rhetoric - Metonymy

In this step, the designer uses metonymy from rhetoric. Based on the similarity of the behavioral text meaning between products A and B, the designer identifies Product B and then substitutes the textual carrier object.

1. See the unconscious behavior as a symbolic text carried by the product, and identify its signified. The signified refers to the concept or meaning expressed by a symbol, which can be understood as the nature and meaning of the behavior.
2. Find Product B that carries a similar signified, and identify the object that acts as the carrier of this signified in Product B (Figure 2.14). In this step, the designer needs to use their personal and design experience to find Product B, with the signified being the essential condition for identifying Product B.
3. Replace the object that acts as the carrier of the signified in Product B for the original object in Product A.
4. Derive the design scheme for Product A based on the replaced object. The schemes derived from the same unconscious behavior should not be used together to avoid contradictions.



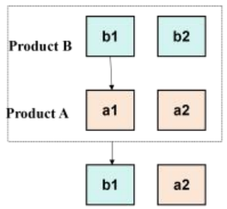
Step 1 Find signified

The signifiant of user's unconscious behavior

The nature, aim and meaning of the behavior.

Step 2 Find Product B based on the similarity of signifiant

The signifiant can be interchangeable



Step 3 Replace Object a with Object b

Replace the product feature fron product B to product A.
Object to object

Step 3 Feasibility Assessment

This step aims to evaluate the feasibility of the concept. The application of Design Route-B involves substituting part of the interaction from Product B into Product A without altering the user's unconscious behavior. This approach aims to improve or innovate the interaction while potentially solving some of the product's issues. At this stage, designers can determine the reasonableness of the final concept based on the following information

- Substitute the design points into the interaction journey or unconscious behavior observation form, and observe whether the application of the design points will interrupt the coherence of using process.
- Whether the design points causes burden to users, such as physical load cognitive load emotional load (Sweller, 1988).
- Place the design point in a specific use scenario or multiple use scenarios where the unconscious behavior occurs, and deduce to see if it meets the set constraints.
- Ask users if they can easily understand the design point or do another observation to validate.
- The added feature needs to comply with the specific product specifications and standards, e.g. check the ADA guideline that corresponds to the product.

Design Route B Application Flow