# Technical Empathy

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**Abstract**

Emotional design is becoming increasingly more relevant across the field of consumer product design because of it its ability to create high value products. By understanding how a consumer thinks and feels, one can create products to cater to their desires, increasing the value of a product to a consumer and making them more likely to buy that product. This is the goal of all consumer product companies. This paper reviews five methods of emotional product design emphasizing (1) how well the method connects the designer to the consumer, (2) cost, and (3) ease of implementation because of these factors' relevance to method adoption by product design teams. This paper suggests that a combination of Personal Construct Theory and Content Oriented User Experience Design is the most effective method of emotional design because of its fulfillment of the above criteria and the complementary nature of its component methods.

**Key Terms**

NPD: New Product Development

UX: User Experience

Emotional Product Design

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## 1 Introduction

In the past 40 years, there has been a radical shift in the way that consumer products are designed. In the 70s, product teams designed things how *they* wanted, having little regard for consumers' needs, wants or desires, and people bought those products because they had no other options. Influential designer Dieter Rams called this phenomenon, "thoughtless consumerism." At that time, a wide gap between the consumer and the designer existed. Since then, it has been realized that the goal of a designer is to make this rift

infinitesimal. In the early years of evolution from thoughtless consumerism to modern product design, designers narrowed this gap by focusing intensely on creating *usable products*, or "pragmatic products" (Hassenzahl, 2018) for their consumers (Hassenzahl, 2018). While this was a step in the right direction, they were still not getting to the root of the interaction: the feeling that a consumer gets while using a product. In the late 80s and into the 90s, "experiential marketing pointed out that customers want products 'that dazzle their senses, touch their hearts and stimulate their minds'" (Hassenzahl, 2018) and emotional product design techniques, such as Kansei engineering, were created to translate those feelings into product features and designs and were implemented to create products with "hedonic quality" (Hassenzahl, 2018). Emotional consumer product design has evolved greatly, and today we live in an age of consumer empowerment which is fueled by a market filled with an array of differentiated products and a high standard of innovation and usability that this competition creates. As a modern product designer, one must recognize this competitive truth, and create products to cater to the emotional desires in order to create successful products and to appease consumers.

It seems that every company, designer, and team has a different outlook on how to approach this difficult problem of translating abstract psychological principles into technical design goals, specifications, and products. I use the term technical empathy to describe the process of understanding consumer emotions through qualitative and quantitative methods in product design to create products that fulfill consumers motivations. Utilizing this philosophy leads to the creation of a valuable, pleasurable, emotional experience for the consumer rather than a product that merely performs a task. I aim to present the most common methods of designing for the user using emotion in the field of consumer product design, demonstrate how these methods can be used in the product design process to narrow the gap between designers and consumers, and evaluate these methods based on (1) how well the method connects the designer to the consumer, (2) cost, and (3) ease of implementation.

## 2 Product Design Process

I will begin by introducing basic product design cycle so that I may reference the various steps in the cycle without confusion from semantical differences in the names of the different parts of the cycle. Wen-Ko, Bi-Hui, Ming-Hsu & You-Zhao (2007) define new product development in their paper "User-Oriented Design (UOD) Patterns for Innovation Design at Digital Products" as "a complex process of ideas associated with a significant measure of innovation." In general, the product design cycle is broken down into six steps (Jacko, 2007). Figure 1 shows a physical product design cycle as presented by Wilpert (2008) in his paper Psychology and human factors engineering. Figure 2 shows a product design cycle for a computer-based product as presented by Jacko (2007). As shown, there are slight differences in their steps and how the steps are broken down, but they are essentially the same. For this paper, I will be using the process defined by Wilpert (2008) in Table 1 because this paper focuses more on physical products.

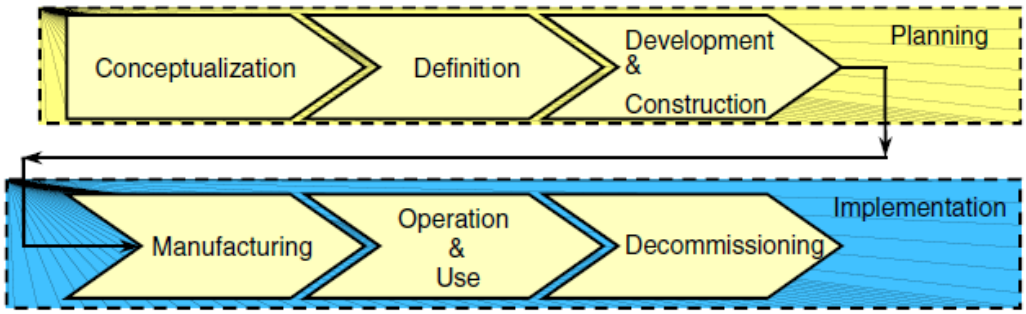


**Figure 1:** Physical Product Cycle (Wilpert, 2008)

**Table 1:** Software Product Design Cycle (Jacko, 2007)

| LIFE CYCLE STAGES | PURPOSE | DECISIONS |
|---|---|---|
| CONCEPT | Identify stakeholders' needs | |
| | Explore concepts | |
| | Propose viable solutions | |
| DEVELOPMENT | Refine system requirements | - Execute next stage |
| | Determine system components | - Continue this stage |
| | Build system | - Go to previous state |
| PRODUCTION | Verify and validate system | - Hold project activity |
| | Mass produce system | - Terminate project |
| | Inspect and test | |
| UTILIZATION | Operate system to satisfy users' needs | |
| SUPPORT | Provide sustained system capability | |
| RETIREMENT | Retire; archive or dispose the system | |

Many of the methods that will be described and compared will be in the "planning" phase (shown in the yellow box) of the product design process because the steps within this part are the most design oriented and have the most opportunity to include consumer/ user emotion.

## 3 Emotional Product Design Methods

The uses of emotion in product design are diversified in method, but similar in goal. The goal of using psychology and emotion in product design is to create products and product features that cater to emotion or feeling. This, in turn, ensures that the product that is made will be accepted, cherished, and most importantly, bought by the user.

### 3.1 Kansei Engineering Type 1

Kansei Engineering is one the most influential methods that has been developed for translating human emotions into design specifications. An influential literature review on this subject titled "Kansei Engineering: A new ergonomic consumer-oriented technology for product development" by Nagamachi (1995) explains three types of Kansei engineering. I will only be discussing the first two types because the third type is based on outdated virtual reality techniques. The first type of Kansei engineering is called category classification and is a visual and intuitive way of converting a feeling into a design requirement. The intuitiveness of this method stems from its graphical nature and the fact that it can be understood by most people who do not have expertise in this field, making it easy to implement. This method works by "classify[ing] the zero level concept to the sub-concepts, that is, 1st, 2nd . . . and nth sub-concept until they obtained the car design specifications." (Nagamachi, 1995). In the case that is presented in this paper, the product that the team is designing is a car and the zero level concept is the idea that the driver and the car are connected and that the car should be an extension of a person. As shown in Figure 2, Kansei Engineering Type 1 is used to break down this emotional concept into more and more subcategories until a physical trait is reached that can be used to design.

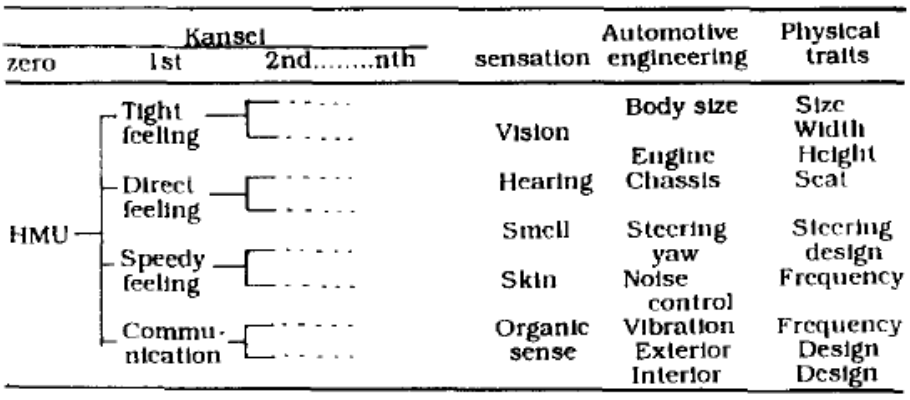


**Figure 2:** Kansei Engineering Type 1 (Nagamachi, 1995)

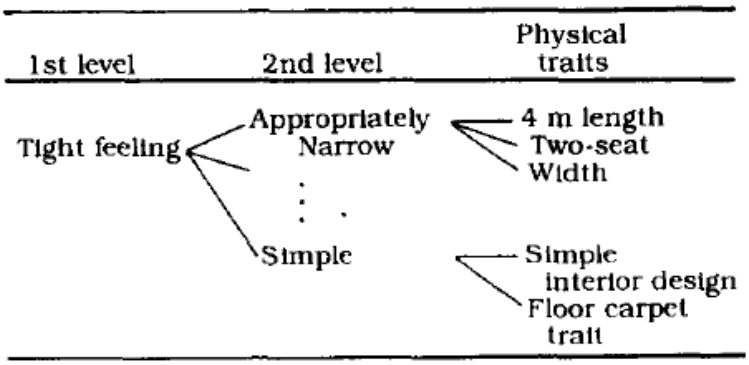


**Figure 3:** Refining Physical Traits from Kansei Concepts (Nagamachi, 1995)

This kind of emotional design is highly useful in the "definition" stage of product design because of its quantifiable outcome. Because of its virtually non-existent cost to implement, and ease of implementation to everyday engineering activities, Kansei Engineering Type 1 stands out as a highly effective emotional addition to the design cycle. Although Type 1 is both cost effective and easy to implement, its ability to connect the consumer to the designer is not as strong as some of the other methods that will be presented because of the high involvement that the designers have in creating the nth-level sub-concepts. This involvement dilutes the consumers feelings and creates a more designer oriented design when compared to other methods.

This method has been proven to be successful in product development: "Through the procedure of Kansei Engineering Type I, Mazda has succeeded in developing the new sports car, "Miyata", which is called "Eunos Roadster" in Japan and has been a good seller in the U.S. as well as in Japan." (Nagamachi, 1995). Additionally, "Numerous products have been successfully developed based on it, e.g. car crash pad, camera form design, home appliances, domestic commodity, and toiletry application" (Huang, Chen, Wang, & Khoo, 2014).

### 3.2 Kansei Engineering Type 2

Kansei Engineering Type 2 is a computer assisted form of Kansei that utilizes four databases of words, images, and consumer behaviors to translate consumer feelings into design details (Nagamachi, 1995). The system works by having a user (the user can either be a designer or a consumer) input emotion and feeling words (also known as Kansei words) into the system that the design should cater to. The Kansei words are gathered from dialogue with salesmen and industry magazines and are representative of the feelings that consumers may have about the product (Nagamachi, 1995). The below graphic shows a visual output of

a Kansei Engineering System (KES). With these words, the computer system outputs a visual that can be used to design.

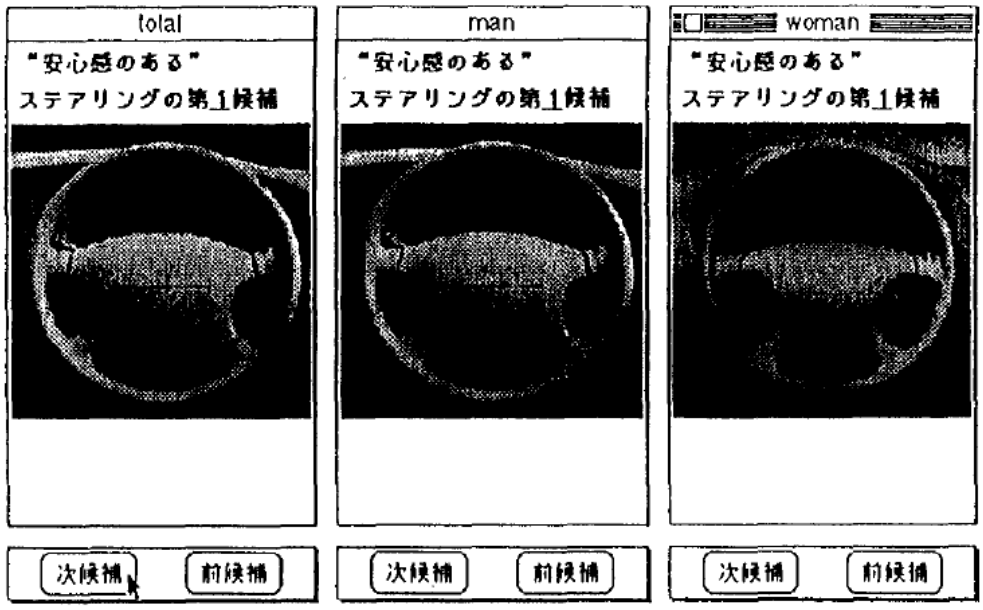


**Figure 4:** Visual Output of KES (Nagamachi, 1995)

This method is straightforward to implement into the product design cycle because of its ability to be used in the both the conceptualization stage of development as well as the definition stage. The conceptual stage, as the name implies, is when different concepts for subsystems and design features are explored, and these KES visuals are catered to this kind of rough concept exploration. With these concepts, the design team can then use Kansei Engineering Type 1 or other design methods to finalize these concepts into product definitions. Additionally, Kansei Engineering Type 2 is highly effective at informing the designers of what the consumers want because it directly translates emotion into design specification, leaving little room for designer misinterpretation of emotion. Unfortunately, this increased translational functionality and ease of implementation comes with long development times and high costs.

### 3.3 Scenario Building

Scenario building is a technique that utilizes gathered information about customers to create scenarios that involve emotional, functional, and experiential issues that the consumer may face while using the product to inform design decisions (Fulton Suri, & Marsh, 2000). Fulton Suri and March (2000) describe this technique as a "development of a series of alternative fictional portrayals involving specific characters, events, products and environments, which allow us to explore product ideas or issues in the context of a realistic future. The medium may vary: written stories, annotated sketches, cartoons, photographs, role-playing, video or live dramatizations" (Fulton Suri, & Marsh, 2000). Figure 5 shows an example of an annotated sketch that was created to model an interaction that a consumer would have with this product and how the user would feel when using the product.

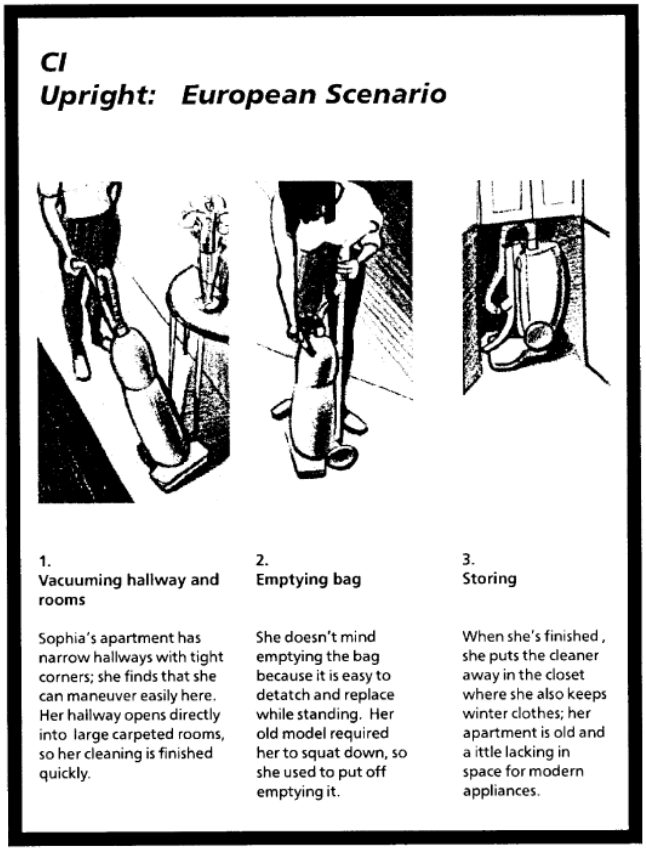


**Figure 5:** Scenario Building Example (Fulton Suri, & Marsh, 2000)

These scenarios are created by ergonomists with careful attention to "mood, goals, tasks, perceptions, expectations and capabilities" of the users as well as attributes of the product such as, 'logic, sound, feel, look, and smell'" (Fulton Suri, & Marsh, 2000). Additionally, these emotions and features are contextualized physically, socially, and culturally to help designers understand consumer scenarios and imagine their feelings.

This method can be integrated into three parts of the product design cycle: Conceptualization, Definition, and Development and Construction. In conceptualization, these scenarios can be applied to create rough ideas about how the product will function and what touch points will need to be created such as, in the above example, the fact that the vacuum must be foldable. In the definition stage, these scenarios can be used to make design specifications such as size constraints. In the example above, the vacuum is stored in a cabinet of a specific size that can be quantified. In the development stage, additional scenarios can be created to verify prototypes and change those prototypes accordingly. Because of its applicability to multiple steps, this method is very easy to integrate. Where this method falls short is its closeness with the consumer. While "ideally this exercise is based upon detailed research of users in context interacting with products, and using methods such as user profiling, field observation, contextual inquiry, protocol analysis and interviews," ( Fulton Suri, & Marsh, 2000) much interpretation of this gathered information is left up to the design team. This can lead to stories that are non-representative of the consumers actual interaction with the product. Additionally, the cost of this method varies proportionally with the amount of information that the team feels that they need to collect to get an accurate representation of the consumers emotions.

### 3.4 Personal Construct Theory

Personal construct theory is highly related to a previously explained method of emotional product design: Kansei Engineering Type 2. Much like Kansei Engineering, three problems must be solved in order to utilize this method: emotional requirements for the product, "relationships between products and the emotional requirements," and "ways to improve product parameters" (Huang, Chen, Wang, & Khoo, 2014). The method addresses the first problem of emotional requirements using Kansei words, as described above in section 3.1 combined with a concept called mind maps, shown below.

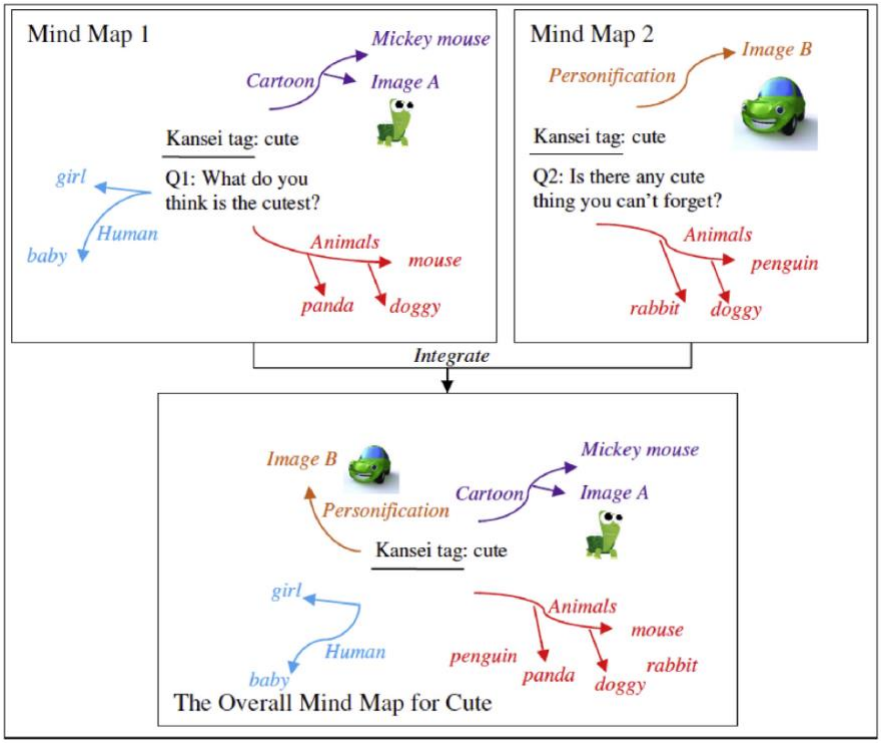


**Figure 6:** Mind Maps in Personal Construct Theory (Huang, Chen, Wang, & Khoo, 2014)

Mind maps 1 and 2 are created by asking the participants of consumer studies to answer the questions that are centered in each of boxes. The answers to those questions related to the Kansei word that is being studied are then placed around the mind map and the mind maps for all the questions are combined. In other words, the design team uses the empirical method of interviewing to generate a database of words that is then weighted based on factors such as frequency which is used in conjunction with the next step in this process. Additionally, it is important to note that this technique differs from traditional Kansei engineering which utilizes only salesmen dialogue and words used in industry magazines to create the list of Kansei words (Nagamachi, 1995). Because personal construct theory includes this consumer inclusion step in its database creation process, it is inherently better at predicting product features based on consumer inputs. The next step of personal construct theory method is critical in the scope of this paper; it relates emotions and feelings to product features by assigning Kansei words to quantifiable product features and is done by, again, utilizing consumer interviews and focus groups. The third step of the personal construct theory method brings the first two steps together and is used to, in conjunction with a third round of consumer interviews and designer input, create prototypes that combine features that evoke the desired emotion.

Similar techniques have been used with different names such as a study on ceramic tile floorings conducted by Agost, & Vergara (2014) that successfully related emotional meanings, "aesthetics, functionality, symbolic values, etc," to consumer emotion (Agost, & Vergara, 2014).

Consumer input is highly present in every step of this method which creates a high level of consumer-designer connection. Although it is highly effective at outputting designs that are customer oriented, it comes at a high development cost because of how time consuming this process is and the requirement of a team to collect consumer data and create statistical programs to analyze that data. Similar to Kansei Engineering Type 2, this method can be implemented in both the conceptualization stage of development as well as the definition stage, but has the added benefit of being able to be implemented into the development and construction stage because of its ability to output "finalized designs" (Huang, Chen, Wang, & Khoo, 2014) that can be tested further.

### 3.5 Content Oriented User Experience Design

While this next method is not from the field of product design (it is from the highly related field of user experience design), the content within it is highly relevant to emotional design. This method takes a much more concept-based approach to evaluate prototype products and inform design changes when compared to previously described methods. In essence, this method breaks down the consumer-product interaction into 4 rings, "How", "What", "Why", and "Wellbeing" (Hassenzahl, 2018). This is a deviation from the standard way of approaching Experience Design which focuses on the pleasure that is from the "the emotional and hedonic benefits associated with product use" (Jordan, 1998). Below is a graphical representation of these rings annotated with examples that of what each one represents in a product interaction.


**Figure 7:** Graphical Representation of Content Oriented User Experience Design

The "How" level is motivated by "Motor-goals [that] are on the sensomotoric level [and] they address concrete, detailed operations, such as pressing a button or reading an instruction." (Hassenzahl, 2018). The "What" level is arrangements of Motor-goals that are used "to fulfill a do-goal," (Hassenzahl, 2018) which is essentially the main functionality of the product. In other words, this is what the product does for the consumer. The next two steps are a bit more esoteric and are highly based in psychological principles. The "Why" level serves as a link between do-goals and be-goals (the psychological motives that motivate do-goals) (Hassenzahl, 2018). It is in this step that Content Oriented User Experience Design surpasses all other previously mentioned methods of emotional design. While other methods correlate emotion and functionality empirically on the surface, this method aims to understand and utilize the motivation behind those emotions and truly understand the consumer on a base level. Because of this high level of utilization of consumer motivation, it stands as creating the highest level of designer-consumer connection. The last level of this model is wellbeing that comes along with fulfilling one's motives though interaction with a product.

This model of emotional design can be implemented in any stage of the product design cycle because it is not so much a method, but a way of thinking. By adopting a mindset like this while designing or conceptualizing any feature, concept, touchpoint, or interaction, a designer can ensure that they are catering to the one of deepest levels of satisfaction creation: fulfilling psychological motivators. Additionally, the cost of implementing this kind of thinking is next to nothing. The downside of this method is that it is not fully developed; it is unclear how consumer motivators can be learned using empirical methods and only models thus far have been used thus far to predict these motivators. Hassenzahl (2018) notes that accounting for differences in motivators between customers is essential to design but offers no explanation on how this can be done.

**4 Summary**

To compare these methods, I have created two tables that list the five presented methods of emotional design and the three factors that I used to compare them, Consumer-Designer Connection, Cost, and Ease of Implementation. Consumer-Designer Connection and Cost were assigned values 0-10 that correlate them to how connected the Consumer and Designer are and how expensive Implementation is, respectively. I have split the Ease of Implementation factor into two parts: Number of Integration Steps; which is the number of development steps that the method can be integrated into and Integration Ease; which is a numerical value that I have assigned (where 10 is very easy, and 0 is impossible). Also, I made two groups of methods: quantitative methods and qualitative methods.

**Table 2:** Qualitative Methods

| Method | Consumer-Designer Connection | Cost | Number of Integration Steps | Integration Ease |
|---|---|---|---|---|
| Kansei Engineering Type I | 5 | 0 | 2 | 10 |
| Scenario Building | 4 | 3 | 3 | 8 |
| Content Oriented User Experience Design | 10 | 0 | 3 | 10 |

While all of these methods can be utilized to create products that are emotionally oriented, Content Oriented User Experience is the most effective based on the criteria above criteria. It's high applicability to all three steps of development, easy to understand nature, and low cost make it a standout method.

**Table 3:** Quantitative Methods

| Method | Consumer-Designer Connection | Cost | Number of Integration Steps | Integration Ease |
|---|---|---|---|---|
| Kansei Engineering Type 2 | 6 | 7 | 2 | 5 |
| Personal Construct Theory | 8 | 8 | 3 | 4 |

Kansei Engineering Type 2 and Personal Construct Theory are very similar in principles but have some key differences in methods. Personal Construct Theory utilizes a more consumer facing approach of relating consumer emotion to known product design features by including the consumer interviews in all steps of its database creation method. Personal Construct Theory can also be applied to more product design cycle phases. In short, Personal Construct theory is a more developed, consumer focused method of Kansei Engineering Type 2. Additionally, the rapidly declining cost of data analysis may make personal construct theory an increasingly attractive option as consumer studies get wider and deeper.

Based on the results presented in Table 2 and 3 and the pitfalls presented in earlier sections regarding each of the methods, I believe that the most effective method of designing for the consumer is a combination of a modified version of Personal Construct Theory and Content Oriented User Experience Design, an integration of the most effective quantitative method and qualitative method. Content Oriented User Experience Design lacks specificity regarding collection of customer emotion and motivators and should be supplemented with the explicit quantitative methods described by Personal Construct Theory such as focus groups, interviews, and mind-maps which could be modified to incorporate questions regarding motivators. Additionally, the statistical methods used to correlate would be highly beneficial in transitioning away from using models of human behavior to using actual data collected from participants. If these two methods could be combined successfully, I believe that the results would be highly influential.

## 5 Conclusion

Product designers live on the edge of productivity, efficiency, appeasement, and creativity. I believe that the factors that were used to evaluate these methods represent these goals well. Yet, there are some limitations of this analysis. Since most product design is done in a corporate setting, many techniques of emotional design are kept confidential for the sake of having a competitive edge. This means that I am unable to evaluate them in this paper. Additionally, not every product project is the same. This paper discusses the most effective methods of emotional design in general, but specific cases could call for different methods or combinations of methods. As an engineer, diversifying one's skillset to include at least a basic understanding of these emotional concepts is critical to creating products that are innovative, intuitive, and influential. To make a product for consumers, one must empathize with them and understand the root of their needs and wants. This means exploring different defined methods of emotional design, evaluating them based on a variety of factors, and selecting the most effective methods so they may be implemented to create better products.

It seems that no industry is excluded from the wave of artificial intelligence and neural network influence, no exception is product design. Nagamachi (1995) identified as early as the mid-90s that artificial intelligence would be influential in the field of emotional design when he identified its integration into emotional design as a problem that needed to be solved. Since then much as been done to integrate it the product design field including a study done by Agha & Alnahhal. (2012) of the successful use of neural

networks to design chairs for school children but little has been done in terms of emotional design. While computers may be able to understand ergonomics of a chair, they cannot yet understand complex human emotions fully. Then again, neither can we.

**6 Acknowledgements**

I would like to thank Tom Akbari for pushing my class and I to take deep dives into subjects; I really appreciate the freedom that he gave us in that class. I learned a tremendous amount about this field through writing this paper, and I have already begun to utilize this new knowledge.

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