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A Literature review on Design for Emotion

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Abstract—Design for emotion aims to improve human well-being. Design for emotion is a multi-disciplinary or inter-disciplinary research field, including art, design, computer science, psychology, education, engineering, and other fields. In the last ten years, there has been an increasing focus on design for emotion in various areas. However, there is no comprehensive literature review to set up a design for emotion research framework. To address this gap, this paper first presents a descriptive review of 66 related papers on this topic and then proposes a research framework for emotional design.

Keywords—Design for emotion; art; design; emotion regulation

I. INTRODUCTION

Emotion is an integral part of daily life and communicated between people [1], and the relationship between our well-being and emotions is inseparable [2]-[3]. Besides, emotions can also influence many aspects of people's lives, such as cognitive processes, learning efficiency [4], and mental health etc.[5].

Emotion is a state of feeling. Merriam-Webster defines this term as a conscious psychological response (such as anger or fear) subjectively experienced as a strong sensation, usually directed at a specific object, and usually accompanied by physical and behavioural changes in the human body [6]. The emotional states are usually displayed dynamically, and emotion is regarded as an episode in personal life [7]. However, in many disciplines studying this topic, there is no universally acknowledged definition of emotion [8]-[9].

There are two general methods for defining the nature of emotions [7]. The first is a human view of emotions. Emotion categories are defined as perception categories that are generated in the brain at birth or learned by inducing regular patterns in the environment. The second method is the "psychological constructionist", which is inherent in the neurobiological and psychological systems that constitute emotional experience. When an essential core emotional state is automatically and implicitly classified as having emotional meaning, a discrete emotional event will appear in consciousness. When people use the "emotional concept system" to classify core emotions, many positive or negative emotional terms will be produced. These terms refer to people's understanding of emotions and how that knowledge is expressed in emotion categories.

Among emotions, there are some with special status, which are usually called the basic emotions [10]. Most

researchers believe that emotions are classified based on these basic emotions [10]. Still, theorists have different conclusions on how many emotions are basic [11], which are basic, and why they are basic.

Design for emotion refers to promoting a certain emotion through design (designed things). It includes design for positive emotions [12]-[13] and design for negative emotions [14]-[15]. Between design for emotion and user experience design, there are many similarities. Emotions and experiences are intangible and changeable [16]. Thus, both design for emotion and user experience design can cause a wide range of emotions through products, including positive emotions and negative emotions. Hassenzahl [16] divides interactive experience design into three levels to understand: Why, What, and How. The Why is the first consideration stage that mainly involves needs emotions, meaning, and experience. The What stage considers mainly what is the interactive product and the functionality of the product. The How stage considers the easy-to-understand, easy-to-operate and aesthetic aspects of the interaction method. This perspective is consistent with Desmet's view of evoking positive emotions through product design [13].

Although the basic design requirements in product design are similar, there are still differences in the priority stages of design considerations. Liz Sanders proposed three design requirements of products: useful, usable, and desirable [17]. The first requirement is useful which means the product should carry out the tasks designed for it; the usable means the products should be easy-to-use and interactive. The desirable represents attractiveness and can bring people pleasant emotions. Most products could meet the basic useful functions, and easy to understand and interactive with people. However, the basic functions are not sufficient to attract potential users, the emotions brought by design have become part of the experience expected in the process of buying, owning, and using [18].

In terms of design for emotion and user experience, there are still some differences. Norman D.A. [16] mentioned in his commentary on Hassenzahl's paper that design has moved from making things look attractive (styling) to something that meets design needs in an effective and understandable way (design research and interactive design) to realize the experience (experience design). Each step is more complicated than the corresponding step was previously, and it must be based on the knowledge learned in the past. Design for emotion can be considered to meet users' emotional needs and to

be based on emotional needs to be fulfilled, and then move to design for user experience.

Emotion has a significant influence on people's daily lives, and it guides people's decision-making. Our emotions make the experiences in our lives more meaningful [18]. The study of people's emotions has always been widespread in many subjects, like architecture [19]-[20], game design [21], healthcare [22], military [23] and tourism [24]-[25]. In recent years, design for emotion has received more attention from researchers, and it is a multidisciplinary research field including art, design, computer science, psychology, and engineering. Although it is a promising field with various opportunities and new technologies, researchers still face different challenges, such as cultural background differences, insufficient samples in research, incomplete emotional theoretical guidelines, ethical issues [26], research environment [27], emotion regulation effects [28], etc. This paper critically reviews emotion research in different fields in the past ten years and takes a "Designers" view to identify research gaps and challenges, and a possible research roadmap.

II. LITERATURE RESEARCH

The descriptive literature review is the core methodology used in this literature research process. It has a systematic procedure, including searching relevant papers, filtering, and classifying based on research aims and questions [26]. First, search the combination keywords of 'design', 'emotion', and 'design for emotion' in title, abstract, and keywords across two databases: Web of Science Collection and ACM. The research focuses on papers published between 2010 and the day of the search (May 2021). The search resulted in thousands of papers and then papers were filtered based on three principles: a) duplications, non-English and availability, b) relevance to design for emotion, c) abstract, keywords, impact factors, and research areas.

Finally, in addition to some prior papers, 54 papers have been chosen from 2010 to 2021, and they cover multiple application areas like Art, Design, Education, Computer science, Health care, Engineering, Multidisciplinary sciences, and Psychology.

III. CRITICAL REVIEW

A. *Design for emotions in Art and Design*

The relationship between emotion and design has always been an intriguing and complicated connection to research. Hassenzahl [16] considered "emotion cannot be designed", human emotion is a momentary perception of behaviour, as Wright and McCarthy [29] noted "it is not possible to design an experience, only to design for an experience." Hassenzahl believes that people own different feelings about a product. He proposed that the satisfaction of the design comes from the recognition of the design by different users. And this recognition depends on the extent to which the design meets people's needs, the situational fulfilment of needs promotes positive emotions [30]. Desmet [31] also points out that an emotion is not elicited by a product, but by the evaluation of the product for our concerns. Thus, when designers

want to further certain positive emotions [32], it is necessary to take a comprehensive overview of potential situations being faced by users [12]. Whereas, for designers, the external environments and internal reflection of emotions influence designers' decision-making and form different design results [33].

Positive emotions can enhance emotional well-being and optimize people's lives [2]. Many frameworks based on different theoretical backgrounds provide inspiration design methods and tools to motivate positive emotions [12]. For instance, examining individual differences in positive emotional granularity (PEG) can examine a person's use of positive emotion knowledge [34]. Yoon, Desmet, and Pohlmeier proposed a design tool called EmotionPrism [35], a collection of movie-sets through actors' hand-object interactions that can match one of the relevant positive emotions. The classification of positive emotions is various, and it is necessary to classify emotions specifically to support designers to impact user's experiences [35]. Before the EmotionPrism project, they discussed the usefulness of PEG, then concluded some benefits that will impact and benefit the product design process, especially for design conceptualization and evaluation [36]. Meanwhile, they developed usage guidelines for positive emotional granularity (PEG) cards [37]. The PEG cards are a useful tool for designers to distinguish nuanced positive emotions through various graphic designs and definitions of each emotion word. Besides, the value of PEG cards also reflects in the process of emotion-focused design projects [38]. These research tools are not only just a guide for designers on how to design but also focus on taking users' concerns and experiences into consideration.

As Klapperich, Laschke, and Hassenzahl considered in [39], design for well-being is a promising approach, and they supposed Positive Practice Canvas (PCC) to support design for well-being. PCC is a guide and notepad to help designers gathering wellbeing-driven ideas]. Besides, self-tracking is also a useful way for people to record their daily habits, food, exercises, mood, etc. According to a survey across Instagram, most frequently used tags are #habittracker and #moodtracker to share their bullet journals. Based on these findings, digital self-tracking technologies were developed and designed to help users reflect and manage their moods [40]. Through users' self-tracking Instagram posts, it is not hard to find one way for people to share their emotions is drawing, which could express the emotions. Like colouring books were prevalent a few years ago (i.e., Secret Garden colouring book), Turturro and Drake proved that whatever kind of drawing could reduce anxiety [41].

Although positive emotions are a meaningful research area, it still needs to see the positive aspect of negative emotions. 'Negative' not means purely negative, as the research shows that negative emotions are attractive, and sometimes they could be considered significant resources in the art area [42]. Through negative emotions research, inspire designers from another aspect to enrich user experiences. Thus, following the research of design *from* negative emotions, Fokkinga and Desmet put forward two components of the view: (a) why people seek negative

emotions may be because people find the benefits in the long run. (i.e., a short, painful weight loss process in exchange for a slim body), (b) protective frames. (i.e., the detachment frame, the safety-zone frame, and the confidence frame.) Based on these two points, they propose a new framework, the “perspective frame,” that explains the conditions of how negative emotions change into positive emotions [15]. Negative emotions cannot be completely disappeared, and for designers, the better way is through design to transfer negative into positive. It is an intriguing start for designers to apply the approach to design processes, and the results showed product concepts are quite intriguing by some examples. The examples all follow the design approach with the three steps: deciding negative emotions for the user context, how and when eliciting the emotion, and choosing which protective frameworks. Besides, the user experiences are also enriched by the process [15].

B. Design for emotions in Healthcare & Computer science

With computer science development [43], the process of emotion research and analysis has been accelerated [44]. Emotion expression can be detected and reflected by computers, like a project that utilizes the computational system named DoPPioGioco to enhance audiences' engagement in live interactive performances [45]. Facial emotion expression detection not only can apply to interactive performance areas but also works in the healthcare field. By gathering the facial emotion expression data [46], the healthcare system can remind users to break and provide some suitable and leisure services to help people regulate emotions [47].

Except for the use of facial emotion expression detection technology to guide emotions [48], the research using the electroencephalogram (EEG) physiological signals for real-time emotion detection is developing rapidly [49]. It is believed that the EEG is more accurate in detecting human emotion, so it has been widely used in emotion research in recent years. People usually wear a head-mounted EEG detection device because emotions are closely related to the prefrontal cortex, frontal cortex and parietal areas of the brain. However, EEG's emotion detection needs to be worn for a long time, which will cause user discomfort feelings such as skin irritation and other problems. Therefore, designers redesign EEG caps according to the textile to improve emotion detection accuracy and user comfort [50].

In the healthcare field, designers can use modern technology-based equipment to help people with disabilities get better understanding and regulating of emotions [51]. Designers established a web-based animated comic for newly diagnosed women with breast cancer. In the process, comics are used as information tools to let patients to repair and regulate their emotions [52]. In recent years, as tablet computers have become more portable and convenient to use, people can use emotion regulation functions by installing tablet computer applications. For example, an assessment game [53] and an application designed for adolescents with Autism Spectrum Disorders (ASD) can help them self-regulate their emotions to adapt to emotional communication with

people in mainstream environments. According to the research paper, it is maybe the first used emotion regulation dedicated to adolescents with ASD by technology support [54].

C. Design for emotions in Education & Psychology

In the past few decades, many researchers have focused on improving young people's social and emotional learning (SEL) skills and capabilities. The SEL programs are developed for young students to improve social and emotional adaptability and enhance academic performance through teaching skills. Based on the SEL program, the RULER Feeling Words Curriculum is part of SEL that aims to complete the education system. The content of RULER has separate vocabulary analyses according to different grades [55]. For children at a young age, emotion teaching ways should be designed more interesting. A study about teachers pretending play-based training is designed to encourage children aged 5 to 6 years to understand emotions and develop socio-emotional competencies. Psychologists found the study results showing that children's emotional understanding is improved under professional emotion teaching and training [56].

Negative emotions can cause many learning problems, and they are also negatively correlated with learning outcomes. Negative emotions are common emotions during the learning process, especially for academic researchers. Thus, researchers designed computer-based video training to regulate emotions. During the process, students are introduced to the topic of emotional regulation. The video training can help deepen students' understanding and assessment of the knowledge of emotional regulation. The results prove that university students better regulate their emotions through the computer-based video training and have a positive impact on learning and studying [57].

D. Design for emotions in Engineering

For designers, understanding consumer sentiment can not only better establish connections between consumers and products or services but also help companies innovate and optimize products and increase profitability. The increase of consumers' positive emotions can promote purchasing power. A study on consumer emotions through the automatic facial expression recognition software FaceReader [58] shows that consumers have different preferences for different styles of patterns. Graphic patterns with simple elements and sharp edges will attract participants' attention, and consumers have more positive evaluations of color patterns than monochrome. FaceReader can be used as an auxiliary tool for designers to help optimize products. This study confirms the importance of using facial emotion recognition to evaluate consumers' emotions with different graphic styles [58].

In recent years, researchers have been curious about exploring emotions in the engineering field [59]-[60], and interactive systems have been increasingly used in public to make people involved in activities. For example, a novel calligraphy interactive system can express the real-time psychological and emotional state of calligraphers through emotional computing and visualization

technology. The system uses mixed animations of fish swimming, raindrops, insects, and thunder to show the author's emotions in the writing process in real-time. At the same time, bystanders can participate in the calligraphy process and understand the calligrapher's emotions through the interactive system [61]. In addition, there is also a multisensory design that provides a new way of emotional communication by enabling individuals to use their senses to express their inner state in a nonverbal manner [62]. For example, eye-tracking technology can act as a sensor to detect the user's emotions [63].

E. Design for emotions in Multidisciplinary Sciences

Having positive emotions can bring many benefits to life and work, such as increased well-being and a longer life span. People are constantly exploring how to have positive emotions. Researchers use models of emotion regulation strategies that include multiple technologies to establish emotion regulation interventions. Through the comparison of an integrative intervention of Positive Emotion Regulation (PER) program to the Loving-Kindness Meditation (LKM) training program, it is found that the withdrawal rate of PER is lower than that of LKM, and the subjective well-being and life satisfaction of participants in the PER program are significantly improved. In addition, negative symptoms such as depression have eased [64]. For patients with depression, the experiment proved that artistic activities could improve depression [65].

IV. CHALLENGES AND OPPORTUNITIES OF DESIGN FOR EMOTION FROM A DESIGNER PERSPECTIVE

In the past few decades, the research on design for emotion has become more and more mature, and many novel attempts and studies have emerged in different fields [12]. Researchers are constantly exploring emotions beyond the design field and combining many other fields' knowledge or technologies to contribute to emotion research. Such as using EEG and other types of equipment to analyze emotions in data to help designers locate user emotions and design for users. However, the field of emotion research will still be affected by factors such as cultural background differences between different countries, users' age or gender differences, long research time, insufficient samples, and so on.

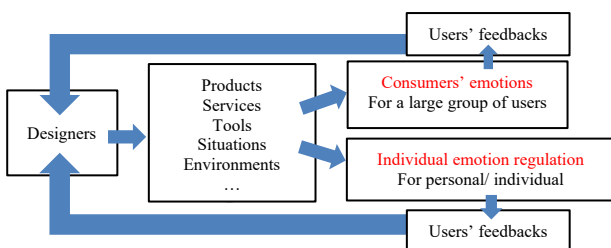


Figure 1. Design for two categories of emotions.

For future works in design for emotion, we propose to research more specifically on two categories: consumers' emotions and individual emotion regulation. The former is on designing for consumers' emotions, which is helpful to design for user experiences; the design aims to provide a large group of users' feelings of pleasure and attract users.

The latter is on designing for individual emotion regulation; the purpose of the design is to improve personal emotions and well-being. As shown in Fig.1, designers, through product design, services design, tools design, situations design, environments design, and so on, influence users' emotions. Then through the feedback of users or individuals to help designers improve their designs.

A. The research framework from a designer's perspective

The design outcomes obtained by designers through different design methods can often affect different user groups or individuals. Personal or users' preferences and emotions are vital feedback for design. User emotions can be detected by questionnaires or modern technologies such as EEG to realize emotion visualization from user emotion recognition. The gap between the user's inner emotional state and the expected emotion state can actually be regarded as the design demand value of the emotion. It can be used as part of design requirement, with the support from design for emotion theories, emotion regulation strategies and application contexts, it can drive designers to better their design solutions, ultimately helping users achieve their target emotion expectations. (Fig.2)

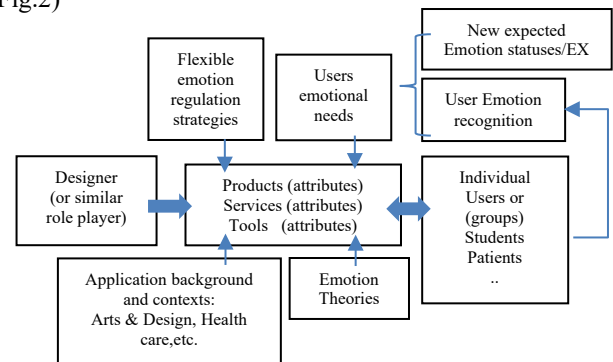


Figure 2. Research framework of design for emotion.

B. Design (things) for consumers' emotion (UX)

Design for emotion mainly has two parts: a design for positive and a design for negative emotion. Positive emotions have a particular connection with improving well-being [66], and positive emotions are also considered to be factors that can enhance happiness. When designing for happiness, designers often consider how to improve users' positive emotions to increase happiness. However, arousing positive emotions does not always increase happiness. For example, some people use marketing strategies to introduce products to consumers for profit, and consumers choose to buy because of temporary positive emotions such as instant surprises or desires. However, when consumers are focusing on the joy of purchase rather than the value of the product itself, the consumers' positive emotions will quickly disappear, and it might cause negative emotions. In fact, the positive emotions that products bring to people disappear quickly [12]. From a long-term perspective, positive emotions should not be defined by the market, but more attention needs to be paid to how the design itself can improve people's happiness. The challenges and opportunities are met when designers bring the emotional product design

and its service design together to make the integrated product and service system emotional.

Although people have some experience exploring emotion visualization, emotion framework, and emotion recognition in many fields, they will face various challenges in designing for emotions such as the gap between emotional data and emotional states. Besides, emotions are complicated, and it is little known what kind of emotion data presentation will support emotion regulation training. Designers usually hope that their designed products can bring certain expected emotions to users, but there will still be deviations in expected values and failure to achieve expected goals.

V. CONCLUSION

Design for emotion has always been a promising research direction. However, it is still full of challenges and research deficiencies, such as cultural background differences, insufficient samples, incomplete emotion theoretical guidelines, ethical issues, research environment, emotion regulation effects, etc. In future research, how to meet the user's personalized emotional needs is also a topic worthy of research and in-depth research. Nowadays, with the changes of the working and life patterns under the pandemic, people's needs for personalized emotional regulation are also increasing. Whether the design is for a large group of users or individuals, its ultimate goal is to satisfy emotional needs and improve people's happiness.

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