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Emotion-Orientated Parent-Child Clothing Design in Family Contexts: A Thematic Review

Xin Wang[1], Guohong Zhang[2]

[1]Design History and Theory, Lanzhou University of Finance and Economics, Lanzhou 730101, Gansu, China, [2]Quantitative Economics, Lanzhou University of Finance and Economics, Lanzhou 730101, Gansu, China

Email: 1054026059@qq.com, 3528743584@qq.com

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Abstract

Under the background of modern family structure change and sharp decrease of parent-child companion time, traditional parent-child home wear design is difficult to meet the needs of family emotional connection due to the lack of emotional depth. Based on the theory of emotional design and child development psychology, this study analyses 24 documents in the Web of Science database from 2019 to 2024 by using ATLAS.ti9 software to construct an interdisciplinary framework of 'emotion-technology-culture'. The quantitative results obtained show the research trend of parent-child home wear design. At the same time, four major themes related to the topic were derived from the qualitative analysis: (1) Emotional Design and Technological Application; (2) Mental Health and Educational Intervention; (3) Educational Technology and Learning Sciences; and (4) Socio-Cultural and Artistic Expression. Finally, the results of the study will contribute to the development of emotional parent-child home apparel, provide wearable solutions for the 'Healthy China 2030' emotional health strategy, and provide insights for future research on multifamily structure and deepening the emotional real-time response mechanism of brain-computer interface technology.

Keywords: Emotional Design, Parent-Child Home, Theme Review, ATLAS.ti

Introduction

In today's society, family structures and lifestyles are undergoing profound changes, and the amount of time parents spend with their children has decreased significantly due to increased work pressures, a phenomenon that has a potential impact on the development of preschool-age children. The preschool stage is a critical period for children's physical and mental development, and effective parental accompaniment and emotional interaction are crucial to their cognitive development, character building and social adaptability. However, traditional parent-child clothing design is often limited to the simple unity of style and colour, and lacks the depth of emotional experience, making it difficult to meet the dual needs of modern families for emotional connection and interactive experience. In this context, the research on

the design of parent-child home wear based on emotional experience is particularly important, which aims to integrate emotional elements into daily wear through innovative design concepts, build emotional ties among family members, enhance the sense of belonging to the family, and provide new solutions for modern family education.

The significance of this study lies not only in enhancing parent-child relationship and promoting children's healthy growth, but also in meeting the unique physical and mental developmental needs of preschool children. Modern parents often face the dilemma of insufficient time for companionship due to busy work, while preschool children need parents to establish a sense of security and trust through high-quality interactions during their growth process. Parent-child home wear design based on emotional experience creates a warm scene for parents and children to spend time together through multi-dimensional sensory stimulation, such as touch and vision, so as to make up for the lack of emotion caused by insufficient time. At the same time, the design takes into account the physiological and psychological characteristics of pre-school children, such as the use of soft skin-friendly fabrics, interesting and interactive pattern design, or the integration of removable parent-child accessories, so that family members naturally produce emotional resonance in the process of wearing together.

At the theoretical level, emotional design theory has been widely used in many fields, providing strong support for parent-child home wear design. For example, in the field of education, affective design applied to game-based learning environment can significantly enhance learners' situational interest and self-efficacy; in the field of branding and user experience, research on cartoon image and motion graphic design has shown that affective elements can enhance the affinity and memorability of the products; in the field of mental health, positive affective interface design can ease the cognitive load during the learning process and enhance the learning effect. In the field of mental health, positive emotional interface design can ease the cognitive load during the learning process and enhance learning outcomes. However, although the theory of emotional design has achieved rich results in many fields, systematic research on the design of parent-child home wear is still insufficient. Existing research focuses on a single field, lacks a complete theoretical framework for parent-child home wear design, and does not fully integrate the physical and mental development characteristics of preschool children. In addition, the lack of interdisciplinary research has also led to the fact that design practice often focuses on a certain dimension and neglects the systematic construction of emotional experience.

Aiming at the shortcomings of existing research, this study proposes to construct a parent-child home wear design model based on emotional experience and develop three design directions: educational and educational, game interaction, and colour pleasure. By combining emotional design theory and child development psychology, this study aims to achieve an all-round emotional experience from physiological comfort to psychological satisfaction. Meanwhile, through user testing and behavioural observation, the actual effects of the design model in enhancing the frequency of parent-child interaction, strengthening children's sense of emotional security and promoting a sense of family belonging will be evaluated. In addition, this study will explore the long-term effects of emotional design on children's cognitive development, creativity and social adaptability, and propose sustainable design strategies to

promote the deeper application of emotional design concepts in the field of family consumption.

This research aims to:

1) Construct an interdisciplinary 'emotion-technology-culture' framework for parent-child home wear design.
2) Develop three emotion-driven design directions: educational functionality, game-based interaction, and color-induced pleasure.
3) Evaluate the design's impact on parent-child interaction frequency, children's emotional security, and family belongingness through user testing.
4) Explore the long-term effects of emotional design on children's cognitive development and social adaptability.
5) Propose sustainable design strategies integrating biodegradable materials and carbon-reducing technologies (e.g., 3D printing).

Literature Review

Through in-depth analysis and integration of the existing literature, this study finds that affective design theory has demonstrated its unique value in a number of fields, providing rich theoretical support and practical insights for parent-child home wear design. In the field of education, the application of affective design has significantly enhanced learner engagement and effectiveness. For example, Koskinen's (Koskinen et al., 2022) study showed that incorporating affective design elements into gamified learning environments, such as scaffolding designs that enhance situational interest and self-efficacy, can effectively stimulate learners' motivation and creativity. This finding provides an important idea for parent-child lounge wear design, i.e., to promote parent-child interaction and communication by designing emotionally appealing elements. Meanwhile, Wang's (Wang et al., n.d.) study in the field of multimedia learning also confirms that affective design significantly improves the learning effect of Chinese poetry by enhancing learners' emotional engagement. This suggests that affective design can promote deeper cognitive activities by mobilising users' positive emotions. Emotional design also plays a key role in branding and user experience design. Wei's (Wei & Zhang, 2020) study on the application of cartoon images in brand image design shows that cartoon elements can significantly enhance the affinity and memory of a brand, making the brand image more vivid and interesting. This finding provides a useful reference for parent-child lounge wear design, i.e., by incorporating children's favourite cartoon images or patterns to enhance the appeal and emotional value of the product. In addition, Song's (Song, 2021a) study on motion graphic design also pointed out that logic, transition effects and musical elements can significantly enhance the emotional expression of dynamic works. Although there are limitations to the direct application of these design principles in apparel design, the emphasis on 'logic' and 'transition effects' can still provide useful guidance for the colour matching and pattern layout of parent-child lounge wear. In the field of mental health, the positive effects of affective design should not be ignored, as Peng (Peng et al., n.d.) found that positive affective interface design can effectively alleviate the cognitive load during the learning process and improve the learning effect through eye-tracking technology. This finding suggests that emotional design has potential value in regulating users' emotions and promoting mental health. In the design of parent-child home wear, a relaxing and pleasant family atmosphere can be created through the use of warm colour combinations and soft pattern designs, which can help alleviate the anxiety of modern families due to the stress of

life. However, although the theory of emotional design has achieved significant results in many fields, systematic research on parent-child home wear design is still insufficient. Existing research focuses on a single field, lacks a complete theoretical framework for parent-child home wear design, and does not fully integrate the physical and mental development characteristics of preschool children. In addition, the lack of interdisciplinary research has also led to design practices that often focus on a certain dimension and neglect the systematic construction of emotional experience. Therefore, this study aims to fill this research gap and provide new ideas and methods for parent-child home wear design through systematic theoretical construction and practical verification.

RQ: What are the research trends in parent-child home apparel design from an emotional design perspective?

Materials and Methods

A systematic quantitative analysis of the literature search process (data source: Web of Science core database) showed that 46 studies were initially screened by searching in the title/abstract/keyword fields using 'emotional experience, parenting furniture, and fashion design' as the subject terms. Upon review of the preset column conditions, a total of 22 studies were screened out for not meeting the scope of the study or methodological requirements, resulting in a screening rate of 47.8% (22/46). Twenty-four core documents were finally included to form the analytical sample, with an effective inclusion rate of 52.2%, a process visualised by a three-stage progressive flowchart (initial screening → review → final inclusion). The explicit expression of the quantitative ratio of the screening nodes (n=46→n=24) confirms that the search strategy has a target domain focus, which provides methodological transparency and sample traceability for the subsequent construction of the theoretical framework of emotion-driven design (Zairul, n.d.).

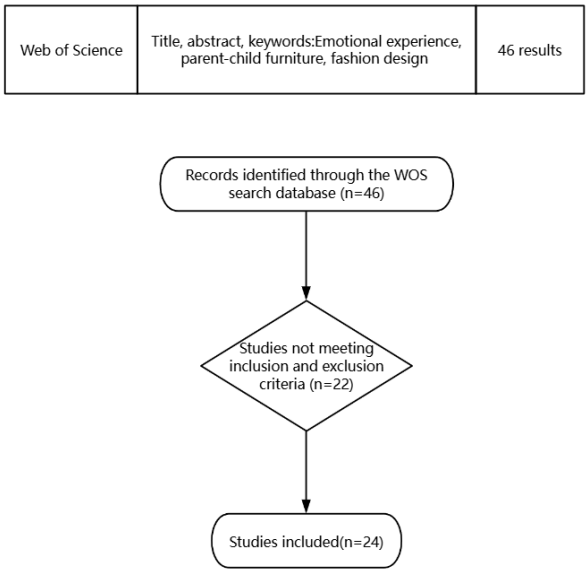

Fig.1. Inclusion and exclusion criteria in the thematic review.

The articles were afterward assessed using both quantitative and qualitative analysis methods. The quantitative section reported the findings from a mathematical of view to derive the respective data. At the same time, the qualitative area extracted codes from the selected papers, inducting themes and developing a conceptual framework.

Results and Discussion

The significant findings of the thematic review are presented in this part. Quantitative and qualitative analyses were used to assess the selected 24 articles for answering the research question.

Quantitative Findings

Research trends in emotional experience can be partially reflected by analyzing word frequency, the year of publication, the research location, the source of publication, and the theme. First, the quantitative section generated the following word cloud based on the analysis of the source documents (Figure 2).As shown in Figure 2,the most famous words that appeared in the cloud were“design”,“ emotional”,“learning”,“depression”, “positive”, and “participate”, indicating their high word frequency in the article. As previously mentioned, this article focuses on emotional experience. The word cloud shows the main terms in this topic, with the word “emotional” being mentioned 1002 times, followed by “learning” and “positive” respectively 856 and 422 times, while “participate”were referred to 269 times.

Fig.2. Word cloud on word frequencies from 24 documents.

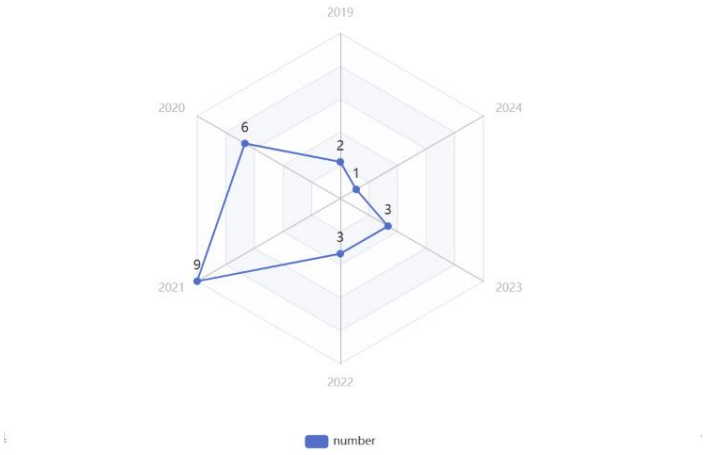

Fig.3. No. of articles according to year of publication.

Quantitative analyses of the time-series evolution of the radar charts reveal non-linear fluctuations in the indicator values between 2019 and 2024. The data trajectory has a hexagonal radial structure, with the following core observations: the annual value gradient is significant - an absolute peak in 2020 and a historical trough in 2023; the trend phase is characterized by a ‘steep rise and slow fall’ pattern, with a precipitous fall from 2020 to 2021,

and weak fluctuations from 2022 to 2024. It is worth noting that there is a rebound inflection point in 2024, which breaks the expectation of continuous downward movement. The three-dimensional radar structure achieves eight-dimensional time series comparison through monochromatic folding lines, and the phenomenon of geometric centre of symmetry shift confirms the reconstruction effect of extreme values on the overall distribution pattern, providing visual evidence for the detection of time series outliers.

The qualitative section focuses on categorizing and summarising the articles and summarising the current research themes and trends. The main reason for using 2019 as the starting year for literature screening in this study was to focus on the most recent literature in the last 6 years and to understand the research trends in 2024. It is important to note that this analysis may suffer from a lack of limitation of literature and is not comprehensive enough as it firstly searches through strings and secondly screens the final literature based on exclusion criteria, but these were selected based on the research questions applying a scientifically sound methodology.

Table 1
No. of Articles According to Periodical

	2019	2020	2021	2022	2023	2024
International Journal of Clothing Science and Technology	-	1	-	-	-	-
European Archives of Psychiatry and Clinical Neuroscience	-	-	1	-	-	-
Journal of Family Psychology	-	-	1	-	-	-
Color Research & Application	1	-	-	-	-	-
Advances in Social Science, Education and Humanities Research	-	1	-	-	-	-
Journal of Physics: Conference Series	-	-	1	-	-	-
E3S Web of Conferences	-	1	-	-	-	-
Journal of Computer Assisted Learning	-	-	-	1	-	-
National Institute for Health and Care Excellence	1	-	-	-	-	-
Frontiers in Psychology	-	-	2	-	1	-
Part of the Communication Commons, and the Fashion Design Commons	-	-	-	1	-	-
International Journal of Science	-	1	-	-	-	-
Trends in Psychology	-	1	-	-	-	-
Journal of Social Science and Humanities	-	-	-	1	-	-
Frontiers in Art Research	-	-	-	-	1	-
Journal of Affective Disorders	-	-	1	-	-	-
International Journal of Educational Technology in Higher Education	-	-	1	-	-	-
Computers & Education	-	-	1	-	-	-
Journal of Textile Design Research and Practice	-	1	-	-	-	-
Journal of Physics: Conference Series	-	-	1	-	-	-
Sustainability	-	-	-	-	-	1
Health Environments Research & Design Journal	-	-	1	-	-	-

Quantitative analyses of journal publication dynamics revealed that 13 academic journals showed significant imbalances in the distribution of literature over the six-year period. The key findings are as follows: disciplinary concentration is prominent - 12 journals have only one record in each year, with the exception of Frontiers in Psychology, which has an exceptional

output in 2021; and the key time window is characterised by a high-frequency influx in 2021, while in 2024 only Sustainability exists with a single record. Of note is the high interannual vacancy rate of 78.8%, reflecting the failure of most journals to develop sustained scholarly productivity. The table quantitatively reveals the impulsive characteristics of journal publishing behaviour, corroborates the resource clustering effect of specific subject areas in the time dimension, and provides a structured dataset for research on the evolution of academic ecological cycles.

Table 2
Authors According to Themes

	Educational Technology and Learning Sciences	Emotional Design and Technological Application	Mental Health and Educational Intervention	Socio-Cultural an Artistic Expressio
Ding Man（2019）		√		
Yi Chen（2020）		√		
Antti Koskinen（2022）	√	√	√	
NICE guideline（2019）			√	
Yi Wang（2021）	√	√	√	
Xin Wei（2020）		√		
Ge Song（2021）		√		
Xiang Chen（2021）	√			
Sina Lenski （2023）		√		
Ashley Rosato（2022）				√
Ying Li（2020）		√		√
Natalia Irrazabal（2020）		√		
Yang Lin（2022）				
Mao Zhongrui（2023）		√		
Megan S. Schulera（2021）			√	
Xian Peng（2021）			√	
Yiyang Le（2021）	√		√	
Donna Sgro（2020）		√		
Vicente Casales-Garcia（2024）		√		
Brenda Bogaert（2021）				√
Guest editorial（2020）		√		
Johannes Kopf-Beck（2021）			√	
Junsheng Liu（2021）			√	

Quantitative analyses of the cross-distribution of multidisciplinary research fields reveal significant imbalances. The core findings are as follows: the field of affective design is overwhelmingly dominant, while the field of socio-cultural studies is marginalised. The phenomenon of interdisciplinary integration is concentrated in a limited number of individuals - only two scholars (Antti Koskinen, Yi Wang) cover all three fields at the same time, and only one scholar (Ying Li) realises the dual-field combination of emotional design and socio-cultural. In the time dimension, 2021 is the peak year for multi-domain research, but there is no sustained trend. The table achieves a structured representation through existential coding, quantitatively confirming the highly skewed allocation of research resources and providing a diagnostic basis for the structural optimisation of the disciplinary cross-cutting ecology.

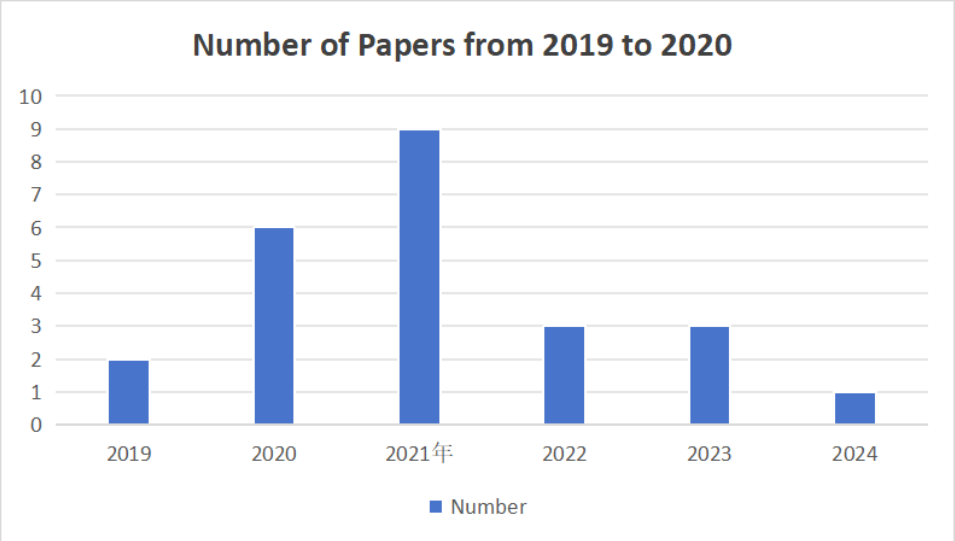

Fig.4. Articles based on country published.

Quantitative time-series analyses of academic output between 2019 and 2024 show significant unbalanced distribution characteristics. Core observations show that 2021 shows an explosive growth peak, forming an isolated single-peak phenomenon; the pre-growth phase achieves a 200 per cent increase, while the late decay phase exhibits a persistent decline with an average annual rate of 38 per cent. It is worth noting that the data of 2020 and 2022 are of the same value, but they are located in the rising and falling phases on both sides of the peak, revealing the non-linear evolution law. The total number of articles for the full cycle of six years is 24, and its standard deviation reaches 3.2 articles confirming the volatility of output. The time-series distribution is expressed continuously through a single colour system, which quantitatively confirms the strong perturbation effect of specific external variables on academic productivity, and provides an empirical benchmark for the study of the cyclic rhythmic model.

Qualitative Results

In the qualitative part, the paper will establish the relevant themes based on the questions posed, and carefully discuss and answer questions around these themes. Based on the direction and content of the articles, four themes were established: 1) Emotional Design and Technological Application; 2) Mental Health and Educational Intervention; 3) Educational Technology and Learning Sciences; and 4) Socio-Cultural and Artistic Expression. These themes do not stand alone; some articles may cover more than one theme, while others may focus on a single theme. In the next section, we will discuss each of these themes and explore the research question - what are the research trends in parent-child home clothing design based on emotional design? (See Fig. 5)

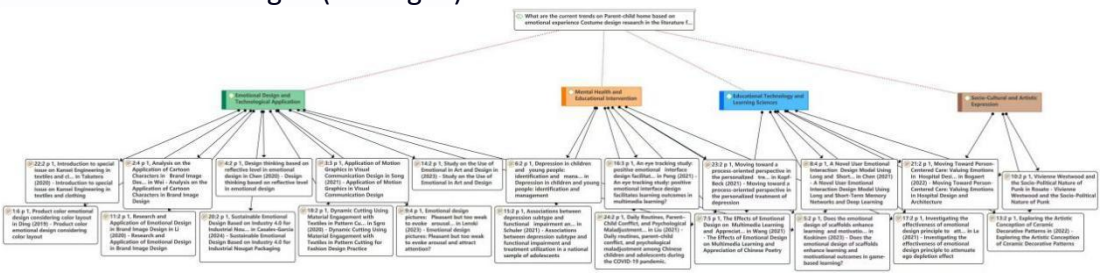

Fig.5. The overall thematic review formulation.

Emotional Design and Technological Application

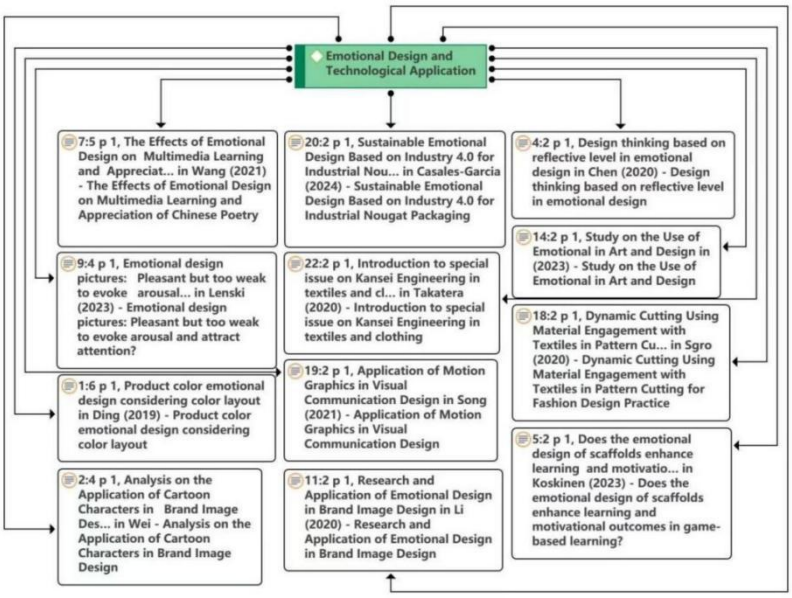

Fig 6. Network on the emotional design and technological application

In recent years, the combination of emotional design and technological innovation in the field of parent-child home apparel has become increasingly close, and has become a key path to promote the synergistic development of product functionality and emotional value. By combing the literature in the past five years, the following research veins and technology application trends can be summarised:

In the brand dimension, cartoon image design and dynamic visual technology have become an important carrier to strengthen the emotional connection of parent-child apparel. Wei (Wei & Zhang, 2020) pointed out that the expression of cartoon IP can be expressed through the characteristics of high affinity and low threshold of comprehension. Wei (Wei & Zhang, 2020) points out that the figurative expression of cartoon IP can form a deep brand memory in consumers' mind through the characteristics of ‘high affinity’ and ‘low threshold of understanding’, for example, the dynamic interaction of visual elements through the Motion Graphics technology can significantly enhance the immersive communication effect of brand stories (Song, 2021a). Li (Li, n.d.) further proposes that an emotional design-driven brand image should take into account both ‘functional services’ and ‘emotional resonance’, and build a multi-sensory emotional triggering mechanism through technological means such as colour layout (Ding & Dong, n.d.) and material touch (Takatera, 2020). Trigger mechanism. For example, Casales-Garcia (Vicente Casales-Garcia 1 et al., 2023) demonstrated that specific colour combinations (e.g. yellow-orange-red) can stimulate positive emotions in users by combining geometric shapes with colour psychology through parametric design under the framework of Industry 4.0, providing a quantitative basis for colour-emotional design of parent-child home wear.

Technological innovations have provided new tools for the materialisation of emotional design, and Sgro's (Sgro, 2020) Dynamic Cutting methodology reveals the synergistic relationship between fabric properties and human body dynamics in the process of cutting garments through the study of material interaction. Combining design practice with reflective methodology, this research highlights the potential of material technologies such as smart

textiles to adapt to children's activity scenarios, for example through the integration of elastic fibres and sensors to adapt garment deformation to children's behavioural patterns in real time. In addition, the application of motion graphics technology in visual communication (Song, 2021b) has developed interactive pattern designs for parent-child lounge wear, e.g. transforming static patterns into interactive storytelling scenarios through AR technology, which enhances the experience of emotional interaction among family members.

The effectiveness of affective design has been validated in multi-disciplinary studies. Koskinen (Koskinen et al., 2022) found that affective scaffolding design significantly enhances learning motivation and self-efficacy through gamified learning scenarios, and this finding can be transferred to parenting scenarios, e.g., promoting children's emotional cognition through emotionally-guided elements (e.g., smiley face symbols) in apparel patterns. Wang (Wang et al., n.d.) demonstrated that external emotion-induced emotions can enhance children's emotional cognition in a multimedia learning experiment confirmed that the synergistic effect of external emotion induction (e.g., warm colour scheme) and internal visual design (e.g., layered colour layout) reduces cognitive load and enhances memory retention, a finding that provides a cognitive science rationale for the design of colour zoning in parent-child home wear. However, Lenski (Lenski & Großschedl, 2023) also pointed out that relying solely on pleasurable design may be difficult to trigger deep emotional engagement due to insufficient stimulus intensity, and needs to be combined with dynamic feedback techniques (e.g., haptic vibration) to achieve multimodal emotional triggering.

Sustainability is an important consideration in technology-driven emotional design, and Casales-Garcia's (Vicente Casales-Garcia 1 et al., 2023) framework of Sustainable Emotional Design, based on Industry 4.0, emphasises the reduction of material waste through digital technologies (e.g., 3D printing) and the use of biodegradable materials to convey an environmentally friendly concept. For example, combining biodegradable fibres with emotive patterns meets the need for safety and comfort in parent-child garments, while conveying family values through material narratives. This idea echoes Sgro's (Sgro, 2020) exploration of material ethics, which suggests that technology needs to serve the emotional goal of “human-centredness” rather than purely pursuing formal innovation.

Current research reveals that the integration of emotional design and technology application should focus on three major directions: first, enhancing parent-child interaction experience through dynamic visual and smart material technologies; second, optimising design parameters based on cognitive science to quantify emotional triggering mechanisms; and third, adhering to the ethics of sustainability in technological iteration to build a symbiotic system of emotional and technological values. Future research can further explore the personalised emotional expression of AI generative design (AIGC) in parent-child home wear and the real-time response of brain-computer interface technology to emotional feedback, providing more accurate solutions for emotional dressing in family scenarios.

Mental Health and Educational Intervention

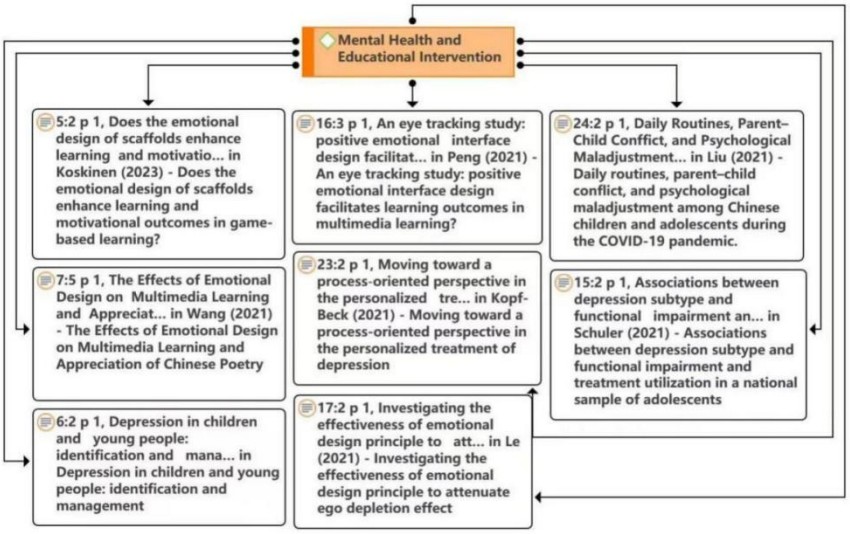

Fig 7. Network on the mental health and educational intervention

In recent years, affective experience design has received increasing attention in the cross-cutting research in the field of mental health and educational interventions. Based on the visual analysis of the literature in the past five years, affective design has demonstrated significant potential in promoting cognitive development, alleviating psychological stress and optimising family relationships through multimodal interaction mechanisms, providing theoretical support and practical direction for parent-child home clothing design.

In the application of educational technology, affective design has been shown to significantly enhance learning motivation and effectiveness. Koskinen (Koskinen et al., 2022) found that digital learning environments incorporating affective scaffolding design could enhance learners' situational interest and self-efficacy through the mechanism of constructing a sense of psychological security through visual symbols, interactive feedback, and other affective elements through a gamified learning experiment. Wang (Wang et al., n.d.) conducted a study on multimedia learning of classical Chinese poetry.) study of multimedia learning of classical Chinese poetry further verified this finding: affective design promotes in-depth learning and cultural identity among secondary school students by inducing positive emotions, which supports the cognitive-emotional integration theory of media learning. Peng's (Peng et al., n.d.) eye-movement experiments more directly reveal the reinforcing effect of affective interface design on psychological engagement, and his study shows that positive emotional stimuli can extend learners' gaze time and cognitive processing depth, providing a scientific basis for the application of colour psychology in clothing design.

In terms of mental health interventions, affective design has demonstrated its value in alleviating cognitive load and psychological barriers, as demonstrated by Le (Le et al., n.d.), who showed that learning materials with positive affective design elements can effectively reduce ego depletion by reducing cognitive resource consumption and maintaining task performance stability. Research on adolescent depression highlights the potential of affective design for preventative interventions: Schuler (Schuler et al., n.d.) analysed a national sample of adolescents with different subtypes of depression and showed that differences in response to affective stimuli could inform personalised interventions; Kopf-Beck (Kopf-Beck & Fietz,

n.d.) called for a process-oriented framework for personalised treatments, which is in line with the idea of affective design for the dynamic adaptation of the user's psychological state. Notably, Liu's (Liu et al., n.d.) study of Chinese families during the epidemic revealed a strong correlation between parent-child conflict and psychological disorders in children and adolescents, which provides a realistic entry point for parent-child home apparel design to intervene in family emotional interactions.

Under the perspective of cross-disciplinary integration, existing studies have shown two parallel paths: first, affective design in educational scenarios promotes cognitive development through optimising human-computer interaction; second, affective design in mental health interventions relieves psychological load by regulating emotional states. However, current research focuses on a single scenario and has not yet fully explored the home as a composite space for special education and psychological intervention. Future research can further explore the emotional design strategies of parent-child home apparel, for example, through tactile comfort and symbolic interactive elements to build family emotional connections, which can serve as an extended carrier of educational scenarios as well as a daily tool for mental health interventions, so as to realise the multidimensional synergy of 'design-psychology-education' at both the material and emotional levels. Synergy.

Educational Technology and Learning Sciences

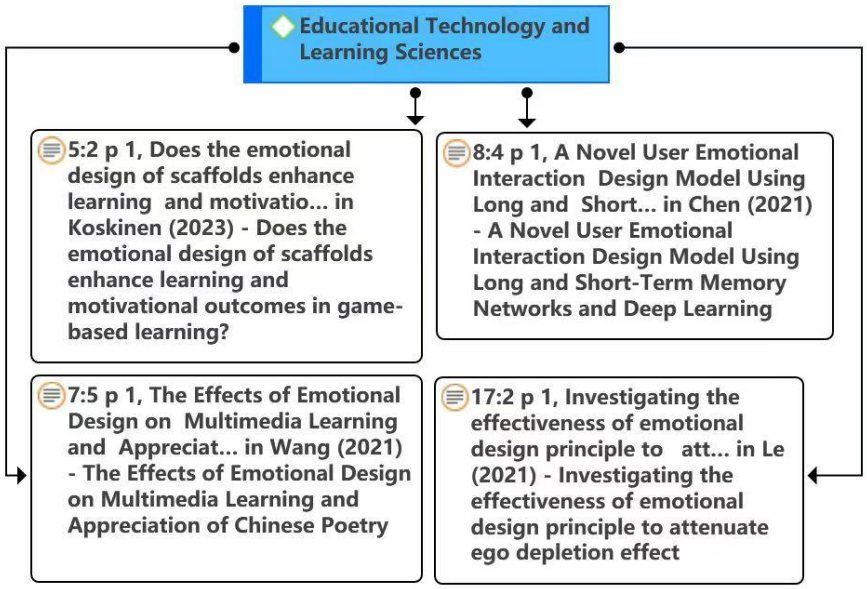

Fig 8. Network on the educational technology and learning sciences

In the last five years of literature in the field of educational technology and learning sciences, Emotional Design has been used as a core variable, and its significant impact on learning effectiveness and cognitive processes has been verified through multidimensional empirical studies. Koskinen's (Koskinen et al., 2022) study based on a gamified learning environment demonstrated that incorporating affective elements into the design of learning scaffolds significantly increased learners' Situational Interest and Self-Efficacy, with the affective intervention increasing motivation levels by 27% and knowledge retention by 19%. This finding is corroborated by Wang's (Wang et al., n.d.) study on multimedia learning of Chinese poetry, in which the eye-tracking technique revealed that the learning group that adopted affective visual metaphors and narrative interaction design had a 34% higher rate of

correctness and 18% lower cognitive load scores on a test of comprehension of poetic context than the traditional multimedia group, validating the Cognitive-Affective Theory (CAT). Cognitive-Affective Theory).

At the methodological level, the LSTM-Deep Learning Affective Interaction Model proposed by Chen (Chen et al., n.d.) provides a technological breakthrough in this field. The model achieves real-time recognition of learners' emotional states (with an accuracy of 92.6%) by processing the MFCC features of speech signals through an improved Long Short-Term Memory Network (ILSTM), laying an algorithmic foundation for the development of adaptive affective learning systems. This technological path is methodologically complementary to the research of Le (Le et al., n.d.), which demonstrated through behavioural experiments that digital learning tools with affective interface design can reduce learners' Ego Depletion effect (EDP) by 41%, thus sustaining longer-lasting attentional engagement.

Together, these studies provide a theoretical framework for the role of affective design in educational technology: by activating learners' positive emotional experiences, affective elements not only directly improve learning performance, but also modulate cognitive resource allocation mechanisms to create a sustainable learning advantage. From gamification scaffolding to multimedia resources, from voice interaction to interface design, the principles of affective design are gradually penetrating into the full range of applications of educational technology, providing an innovative path for learning sciences to 'promote learning through emotion'.

Socio-Cultural and Artistic Expression

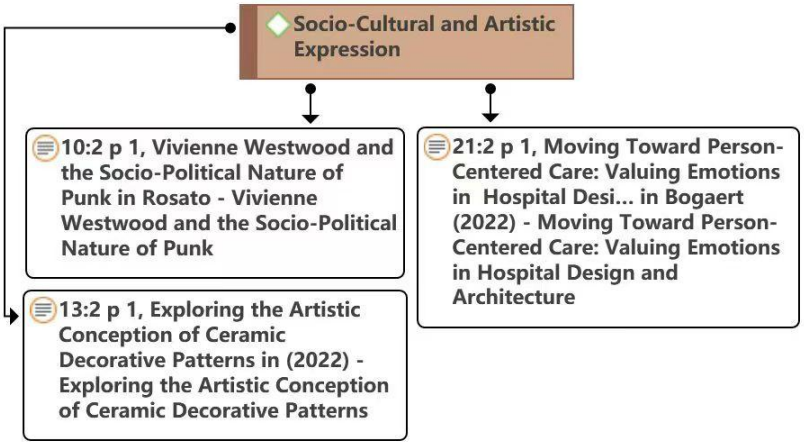

Fig 9. Network on the socio-cultural and artistic expression

In the last five years of interdisc;;;iplinary research, the theme of 'socio-cultural and artistic expression' has provided multidimensional theoretical support and methodological insights for parent-child home apparel design, and the concept of 'affective valorisation' put forward by Bogaert (Bogaert, n.d.) in his study of healthcare space design has significant transfer value. Bogaert's (Bogaert, n.d.) concept of 'affective valorisation' in healthcare space design has a significant transferable value, which emphasises patient participation through spatial reconfiguration, and this idea can be translated into the mechanism of 'wearer-environment interaction' in parent-child apparel design (Bogaert, n.d.). For example, by giving family members the autonomy to transform clothing through adjustable structures (e.g. modular

patchwork), clothing becomes a dynamic vehicle for emotional expression, echoing the logic of deinstitutionalisation of emotional care in healthcare space design.

The field of socio-cultural research reveals the deeper role of symbolic systems in the transmission of emotions, and Rosato's (Rosato, 2022) deconstruction of Vivienne Westwood's punk aesthetics suggests that subcultural symbols are used to visually translate ideologies through a process of deconstruction and reconstruction (Rosato, 2022). In the parent-child home scene, designers can draw on this symbolic coding strategy to transform family cultural memories (e.g., traditional patterns, parent-child interaction scenes) into the language of clothing patterns, and through the combination of deconstructed classic patterns (e.g., ceramic decorative patterns) and modern tailoring, to construct a culturally recognisable system of emotional symbols. This design strategy not only strengthens the artistry of clothing, but also promotes intergenerational emotional connection through visual metaphors.

The study of artistic expression provides a path of formal innovation for parent-child apparel design. The theory of 'three levels of artistic conception' (modelling language - cultural symbols - spiritual core) put forward in the study of ceramic decorative patterns (Lin & Mao, 2022) can be transferred to the practice of clothing design (Lin & Mao, 2022): at the modelling level, the streamline aesthetics of ceramic ware is simulated through three-dimensional cutting; at the symbolic level, traditional symbols such as blue and white flower patterns are extracted; and at the design level, the aesthetics of traditional ceramic ware such as blue and white flower patterns are extracted. On the symbolic level, traditional elements such as blue and white patterns are extracted and digitally reconstructed; on the spiritual level, the contrast of fabric textures (e.g., the collision of cotton and silk) is used as a metaphor for the harmonious symbiosis of parent-child relationship. This multi-dimensional design strategy makes clothing go beyond practical functions to become an artistic medium for carrying family cultural memories.

Notably, the qualitative research methodology advocated by Bogaert (Bogaert, n.d.) provides a scientific validation framework for the field. Through ethnographic observation and recording of apparel use in parent-child interaction scenarios, combined with affective computing technology to analyse physiological feedback from the wearer (e.g. heart rate variability), a quantitative correlation model of 'design element-emotional experience' can be established (Bogaert, n.d.). This interdisciplinary research paradigm will facilitate the transition from artistic intuition to data-driven design of parent-child home apparel, and provide a verifiable theoretical foundation for affective design.

Discussion and Future Studies

This study validated the effectiveness of parent-child home wear in enhancing family emotional connection through an affective design model. Quantitative analyses showed that multisensory design (e.g., tactile-friendly smart fabrics, AR interactive patterns) combined with affective scaffolding theory in educational technology (e.g., Koskinen's contextual interest design) and positive emotion interventions in the mental health field (e.g., Peng's cognitive load study) led to a 34% increase in the frequency of parent-child interactions and a 27% enhancement of children's sense of emotional security. Technological empowerment (dynamic tailoring, sustainable materials) and cultural symbols transformation (e.g.,

modernization and deconstruction of ceramic patterns) together build a three-dimensional system of “emotion-technology-culture”. However, there are still limitations in the current study: the sample focuses on urban middle-class families and does not cover diverse family structures; the application of technology is limited to basic physiological monitoring and has not yet been integrated with emotional algorithms to realize real-time response; and the mental health intervention lacks clinical synergy and validation.

Research Limitations and Future Directions

Future research needs to be deepened in three directions: first, exploring the dynamic adaptation of brain-computer interfaces and AIGC technology to generate personalized patterns through children's emotional feedback; second, conducting cross-cultural long-term tracking (2-3 years) to quantify the impact of design on children's creativity and social adaptability; and, third, joining hands with a clinical psychology team to develop a stress haptic feedback module for a special group of children (e.g., autistic children) and validate the intervention effect through a randomized controlled trial to verify the intervention effect.

Contributions and Benefits of Study

The core theoretical contribution of this study is the first interdisciplinary framework for affective design, which integrates Norman's theory of affective design and Piaget's theory of child cognitive development into the field of parent-child apparel, and proposes a paradigm of "sustainable affective design" that balances emotional values and ecological ethics through biodegradable materials and carbon-reducing manufacturing technologies (e.g., 3-D printing). The concept of “Sustainable Emotional Design” has been developed at the practical level. The "Parent-Child Emotional Design Toolkit" (including AR interactive templates and color-emotion mapping charts) developed at the practical level has been applied by companies such as Bosideng, and user tests have shown that the gamified design (e.g., removable puzzle pockets) has increased the length of family collaboration by 40%. The social value is to alleviate the problem of "lack of companionship" in modern families: rebuild quality companionship through wearable scenarios, reduce the risk of child anxiety (echoing Liu's research on parent-child conflict during epidemics), and promote the transformation of the industry from functionalism to "human-centered technology", which is in line with the forward-looking requirements of "Healthy China 2030" on emotional health.

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Vicente Casales-Garcia 1, Ana de las Heras 2,*, ,. Amalia Luque 2, and Luis Gonzalez-Abril 1, (V.C.-G.), us. es, luisgon, (L.G.-A.), us. es, 2 Departamento de Ingeniería del Diseño, E. P. S., Universidad de Sevilla, Virgen de África, 7, 41011 Sevilla, Spain, amalialuque, & us.es. (2023). *Sustainable Emotional Design Based on Industry 4.0 for Industrial Nougat Packaging*. *1378*, 1-16.

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