

Research on Emotional Expression of Daily-use Ceramic Product Design Based on Meta-model

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Objectives:: Modern people's pursuit and consumption of ceramic products are different from those in the past. Therefore, designing new daily ceramic products full of enthusiasm, touching and spiritual enjoyment is our constant pursuit of innovative goals. The design of daily-use ceramics has developed from satisfying the needs of life at first to pursuing the individuality and emotion of products at later stages, showing different cultural connotations and pursuits in each stage of development. **Methods:** Information objects under meta-model are obtained by extracting the characteristics of project management information and product design information, reflecting the relationship between information entities, while knowledge objects are obtained by associating related information objects. **Results:** Emotional information products have more understanding of human psychology in the design process, which runs through the whole process of product interaction design. **Conclusion:** Through theoretical analysis of emotional design and analysis of a series of classic design cases of daily ceramic products, emotional expression forms of daily ceramic product design are summarized, and emotional design products that can bring people better use experience are designed.

Key words: meta-model; daily ceramics; product design; emotional expression
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The design of daily ceramic products is mainly to determine the morphological characteristics of the products as a form of expression that unifies functions with aesthetic feeling, science and technology with art. The application of meta-model design concept in daily ceramic modeling design is to select different raw materials based on the actual needs of life ¹. Metamodels are models about models. The knowledge meta-model is based on the definition of meta-object facility for image management organization, and provides early data and theoretical support for design through emotional research. Its purpose is to study the user's feelings in the process of using the product, and may be close to or avoid the product in emotion ². It will be able to effectively reuse the domain knowledge, design rules, design methods, design experience and

other design knowledge in the existing product scheme design process, which not only supports the extension reuse of product scheme design results, but also supports the extension reuse of product scheme design behavior and design process ³. Designs and products in the Chinese market have lost the design elements of local culture. Chinese consumers are passively consuming ceramic designs disseminated by Western culture, and then slowly lose the ceramic culture inherited from thousands of years of local history ^{4,5,6}. The design of emotional appeal is mostly for the purpose of promoting people to have positive emotions. It enables users to acquire positive emotional experience after purchasing or using products. This experience includes security, pleasure, interesting, excitement, warmth, pride, self-confidence and so on, and ultimately achieves

emotional satisfaction ⁷.

With the development of various new technologies, the design of modern products is increasingly the integration of knowledge, information and technology. The products are complex multidisciplinary products with complex customer requirements, complex product composition, complex product technology, complex manufacturing process and complex project management ⁸. Daily ceramics are indispensable in people's daily life, and they are ceramic products with the highest frequency, mainly referring to ceramic catering containers, which must have specific use functions and corresponding aesthetic forms ⁹. Learning from the long-used modeling, decorative colors, decorative themes, capacity, matching, etc., in order to meet and adapt to the custom psychology of consumers, make consumers easy to identify and remember in the purchase, and enhance their trust ¹⁰. Daily ceramics are closely related to people's food and beverage, such as tableware, tea set, coffee set, wine set, tableware, etc. Many of them are ceramic utensils. Ceramic is also the most common decorative display in life. For the appreciation and use of life, daily-use porcelain has shown its own value ¹¹. Pay attention to whether the product can satisfy consumers' own personality, make their physiology and psychology fully obtain pleasant emotional experience, the purpose of consumption is more emotional needs of consumption ¹². The aesthetic taste and artistic tendency dialyzed out by the form, decoration and glaze color of ceramic products are closely related to social history, religious beliefs and local customs, giving people emotional sustenance and spiritual enjoyment, which also shows the attributes of spiritual and cultural products of ceramics ¹³.

The separation of information description and physical data is realized through meta-model. Knowledge objects are obtained through further analysis and processing of information objects. If the establishment of information objects is to realize the navigation and physical association of explicit knowledge. In the communication with the user, the user's favor and understanding can be obtained emotionally ¹⁴. Identifying the user's personal information and actively taking countermeasures according to the characteristics and needs of the target users are

the basic aims of interactive product design. Extension transformation can not achieve the ideal reuse effect, but will increase the complexity of the design process. Therefore, the extension reuse degree is proposed as a measure of the reuse degree of primitives, and the expanded primitives are screened ¹⁵. The subjective emotion expressed by designers can be correctly conveyed to people and resonate with human emotions, thus touching people's emotional world and prompting people to accept and love such products ¹⁶. The key is an emotional resonance. Ceramic materials have natural affinity and plasticity, and rich expressive force of glaze color and glaze color, making daily ceramics have considerable advantages in emotional expression ¹⁷. Generally speaking, the emotional expression of daily-use ceramics is mainly reflected in three aspects: shape, glaze and decoration. To meet people's needs, we should adopt appropriate design techniques to meet people's needs ¹⁸. Design reflects the concern for the humanistic spirit, which is the inevitable result of highly developed civilization, social progress and human development. The formal aesthetic feeling of daily-used porcelain modelling keeps pace with the steady progress of the times in an attitude of giving people pleasure ¹⁹. The artistic design of products expresses the artistic feelings of product designers in aesthetics, and emotional expression becomes a new form of value expression of products. This paper studies the emotional expression of daily-use ceramic product design based on meta-model ²⁰.

In this article, we propose a meta-model algorithm, which is an algorithm for emotional expression analysis of daily ceramic product design.

In summary, our contributions are as follow:

- 1.This algorithm is a meta-model algorithm, which is a new algorithm to solve the difficult problem of emotional expression analysis in daily ceramic product design.

- 2.This algorithm is widely applicable in the meta-model environment, and it is highly applicable to the emotional expression of daily ceramic product design.

- 3.This algorithm has higher recognition, strong visualization and accurate accuracy.

Nikitsin V et al. will rely on their own understanding and thinking of knowledge in 2015 and analyze the connotation of knowledge with examples to understand the characteristics

or essence of certain knowledge. From the perspective of system implementation, indirect knowledge transformation is simpler and is also conducive to stimulating designers' creativity. Among different interactive products, products have become an experience under the scene. When new products or new functions not only meet people's needs²¹. Tanaka R et al. studied the distance calculation of extension reuse based on Extension Theory in 2016, set different extension reuse threshold TS0, and can also get the corresponding extension reuse set, which is limited to space, so it will not be repeated here. The consumer market corresponding to emotional design of ceramics products will be more orderly and targeted. The diversification of emotional choices of consumers and the development of fresh share of consumer market will also be the greatest value of emotional design in ceramics products. Designers through their own understanding and understanding of the shape of daily-use ceramics, excavate and create the shape factors with emotional characteristics, and convey them to users through products. The product attracts consumers' interest through its own decoration, which makes consumers interested in further understanding product function, quality and other aspects of information. Different color decoration conveys people's awareness. Different warming colors can give people warm associations, while cold colors make people feel cold²².

Souza H N et al. proposed the use function of ceramic products in 2016, which is based on the physiological needs of human beings and results from human vision, touch and application. It complements this physiological and psychological effect and is inseparable from modern design considerations. Designers should consider two aspects: human physiological conditions and human spiritual factors. A meta-model based modeling method for complex systems is proposed, which integrates the subsystem models of complex systems at a higher level and accelerates the design and development of complex system simulation. Make full use of the materials and technologies suitable for their grades. Design the shapes and decorations suitable for them, highlight their respective characteristics, facilitate consumers' identification and memory, and meet the consumption needs of different levels²³. Silva R V et al. studied the

combination of usability and aesthetics of products in 2017, pointing out that "the aesthetic sense of artistic form of products should not be sacrificed because of the pursuit of ease of use of products". In this way, people's emotions about products are integrated with aesthetic objects. The foundation of formal beauty is not only to cultivate intellectual beauty, but also to cultivate formal pleasure. The theory emphasizes the innovation of product design concept from different perspectives. Only by resonating with consumers' emotional needs can people create satisfactory products and further stimulate consumers' purchasing desire. The application of original ecological materials and other topics to convey different ideas to consumers so that consumers can choose what they like on the product function and cultural background, and can also remind consumers of the importance of natural resources and traditional processes²⁴.

METHODS

Main Ways to Express Emotions in the Design of Domestic Ceramic Products

Different materials have different expressions in ceramic process design. The texture and visual perception of clay form the unique sensory enjoyment of ceramic products. Therefore, the designer must not be able to pursue a certain element in the design, which should be natural and loyal to the nature of the material. Designers take consumers' emotional and spiritual needs as conceptual concepts, so that users can obtain pleasure and satisfaction in the interactive experience with products, thereby further increasing the joy of life. It's not enough for a design to just get rid of its own feelings. It must integrate and stimulate the user's feelings while maintaining a middle tone. In the design full of inspiration and passion, only the highest level of emotions can stimulate the passion of others. The main ways of emotional expression in the design of daily-use ceramics products are shown in Table 1 and Figure 1. The design of related products, including its BOM, design documents, models and various design specifications. Since specific information of projects and products has been recorded in the examples of information classes, the main function of knowledge classes is to establish and maintain the correlation between information classes. The products in the scene will easily bring a sense to users. Of course,

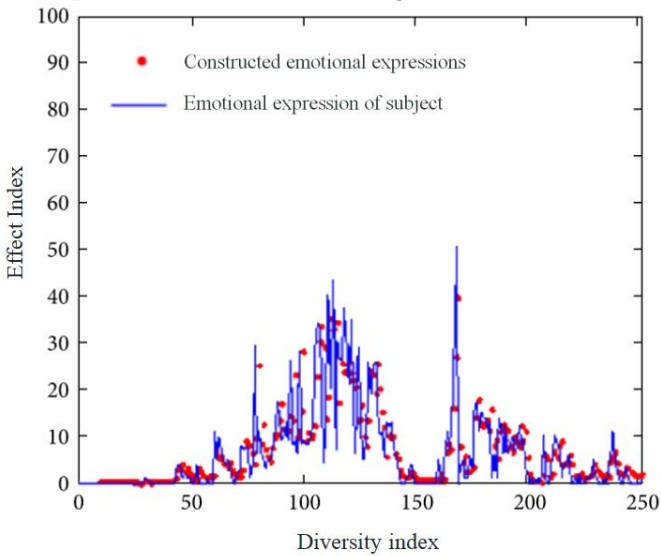
users will have different feelings under different scenes. For a single design behavior and design process, only the extended primitive that can best meet the design requirements is generally required, so the extended primitive obtained through extension transformation and meeting the extension reuse degree must be optimized. The millennium of historical development has

expanded human's material products. When people pass through a period when material life can be satisfied, satisfying emotions and expanding hearts will inevitably become the basic direction of human's new creation activities. Features are used by designers in ceramic design to express mood, to help people produce positive emotions and to absorb emotional strength.

Table 1
Main Ways to Express Emotions in the Design of Domestic Ceramic Products

| | Diversification | Effect |
|--------------------------------------|-----------------|--------|
| ConstructedEmotiona l Expressions | 16.52 | 13.04 |
| Emotional Expression of Subject | 17.15 | 16.04 |

Figure 1
Main Ways to Express Emotions in the Design of Domestic Ceramic Products



Emotional Related Elements in the Design of Domestic Ceramic Products

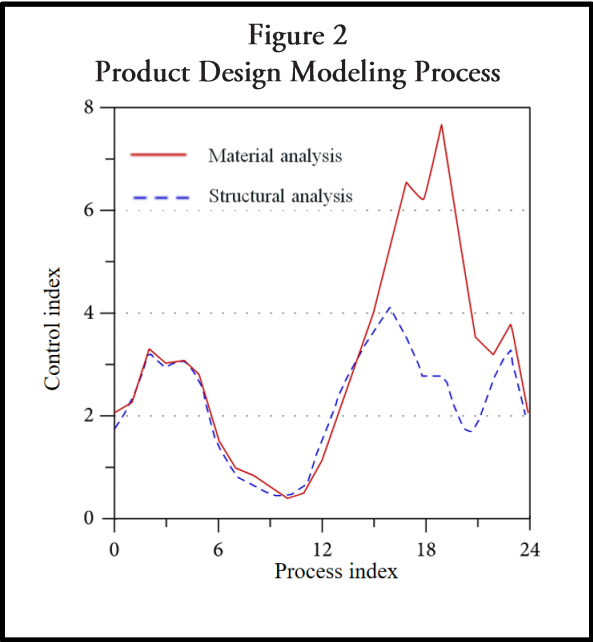
The designer of modern ceramics is based on the traditional culture of his own nation and takes the cultural gene in his own blood as a link to rethink the design of modern ceramics. It is undoubtedly a shortcut. However, this common cultural soil can facilitate designers to pour out their feelings, and the audience can understand it more easily, resulting in tacit understanding of spiritual communication. Due to the complex functions of complex multidisciplinary products, the functions of the products need to be decomposed into sub-functions; Subfunctions are realized through the behavior of the product, which is the physical principle and behavior method on which the function is realized. The process parameters of product design modeling are shown in table 2 and Figure 2. the advantage of meta-model method is that the association between various object entities can be described conveniently through attribute definition and relationship definition of classes. at the same time, the database and prototype system of knowledge

management system can be established conveniently according to meta-model. The integration into ceramic art works shows the connotation of the works and the interesting ideas and situations. In order to pursue the connotation and personal style of ceramic art and design works, one must first seek the uniqueness of one's own emotion and thought. Make it produce emotional resonance, realize the emotional value of the product, so that consumers no longer only owns because of use, but also owns because of love, full of emotional investment in the product. Other aspects of daily-use ceramics must depend on the shape, with the help of the shape to achieve and exist, must rely on the expression of the appearance to have specific significance, and appropriate decoration can also increase the interest and personality of the design. Products should be influenced by natural forces to form the beauty embodied in process design, to a certain extent, can also be said to be the beauty of materials. Design philosophy is to respect tradition, inherit the concept of local materials to truly achieve a masterpiece.

Table 2

Product Design Modeling Process

| | Technology | Control |
|---------------------|------------|---------|
| Material analysis | 9.18 | 10.20 |
| Structural analysis | 7.13 | 9.05 |



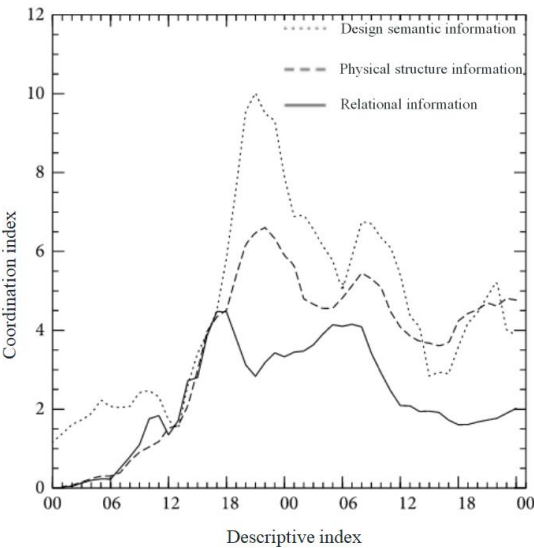
Relation definition mainly describes the relationship between objects, which is used to construct knowledge maps, and describes the relationship between information objects and physical data, so that users can access knowledge objects and further link to relevant knowledge data. Get users'attention and favor in emotional communication. Therefore, interactive products based on emotion need to be analyzed around users, scenarios and requirements. The degree of advantages and disadvantages of evaluation factors and their possible changes require that the optimum

conditions be formulated according to technical requirements, design requirements and other design constraints and constraints. Instinct, intuitive requirements, and correspond to them. In short, the emotional design of ceramic products, can better reflect the value, not only has the function of instructions, but also has the role of emotions. Colors are mostly the essential characteristics of the performance, such as red roses, green grass and so on. They rarely express emotions with the characteristics of color brightness and purity, and rarely form daily ceramic sets with color matching to meet people's emotional needs. Reasonable use of consumer opinions, designed products to be closer to the real needs of people, which is also the requirement of humanized design. According to different living habits and customs of people everywhere, ceramic products with local characteristics should be designed to achieve harmony between products and people. Adhere to the trinity design concept of economy, humanity and society in product design, and devote to the improvement and development of human life environment, so that products can meet people's dynamic material life needs and spiritual life needs, and daily ceramic products can adapt to their environment according to people's needs. The design content analysis of the product is shown in Table 3 and Figure 3.

Table 3
Analysis of Product Design Content

| | Describe | Coordinate |
|--------------------------------|----------|------------|
| Design Semantic Information | 3.25 | 2.91 |
| Physical structure information | 4.17 | 3.18 |
| Relational information | 4.05 | 4.73 |

Figure 3
Analysis of Product Design Content



RESULTS

Primitive Description of Knowledge Unit

The design of daily-use ceramics is also a kind of cultural design, and culture is the sum of material, style, technology, customs and beliefs that human society constantly creates, so the modern design of daily-use ceramics only digs deep into the cultural connotation of the nation. Determine the executor and schedule of each task. In the process of project execution, it is often found that the actual situation is different from the original plan, and needs to be adjusted. The contents of adjustment include changing the decomposition structure of the project or product, and changing the executor of the task. Functionality of human-computer interaction and experience of emotional interaction. The primary responsibility of designers is how to

create a lasting behavior, which can reflect the characteristics and elements of human beings, and create the interconnection between people through technology. In the description of the basic elements of knowledge units, the extension transformation of the existing basic elements by multi-level rhombus thinking often expands more basic elements, and some expanded basic elements are closer to the design requirements. based on this, the extension transformation is carried out. the extension reuse strategy of multi-level rhombus thinking is shown in Table 4 and Figure 4. Use environmentally friendly materials to replace the application of non-renewable resources. The existing primitives are expanded according to their divergence, expandability, conjugation, implication and correlation. the relationship between the extension set of primitives and the extension reuse set of primitives is shown in Table 5 and Figure 5.

Table 4
Extension Reuse Strategy of Multilevel Rhombic Thinking

| | Evaluate | Change |
|----------------------|----------|--------|
| Extension Rule | 16.26 | 19.25 |
| Extensible Reasoning | 14.13 | 15.17 |

Figure 4
Extension Reuse Strategy of Multilevel Rhombic Thinking

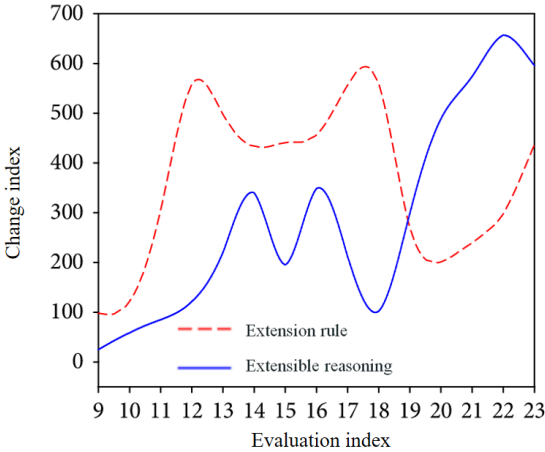
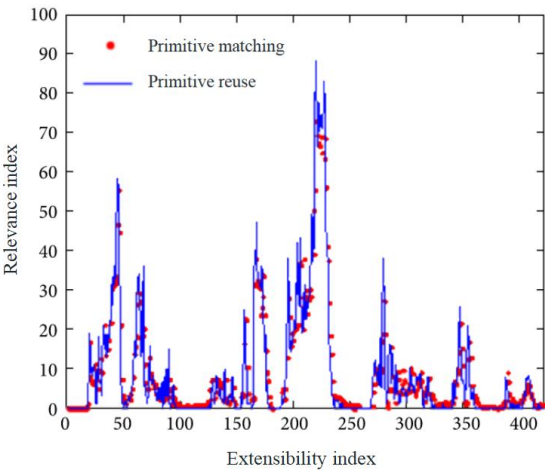


Table 5
Relation between Element Extension Set and Element Extension Reuse Set

| | Extensibility | Relevance |
|--------------------|---------------|-----------|
| Primitive matching | 0.25 | 0.32 |
| Primitive reuse | 0.36 | 0.29 |

Figure 5
Relation between Element Extension Set and Element Extension Reuse Set



Under the condition of meta-model, the knowledge extension reuse set Q for primitives

will be the limited primitive extension reuse set T . According to the formula:

$$Q(u_{ij}) = \sum_{i=1}^n \text{Max}_{1 \leq j \leq m} \{g_{ij}(T)\} \quad (1)$$

The materiality of the design object is expressed by the conjugate characteristics of the virtual and real elements, the soft and hard elements, the latent elements and the negative and positive elements:

$$y_{f-n_m} = \sum_{i=1, i \neq n}^N \sum_{l=1}^M \sqrt{p_{li}} h_{i,n_m}^T w_{i,i_l} s_{i_l} \quad (2)$$

$$P_{f-n_m} = \sum_{i=1, i \neq n}^N \sum_{l=1}^M p_{li} \|h_{i,n_m}^T w_{i,i_l}\|_2^2 \quad (3)$$

The preconditions of the rules specify the initial conditions PS-1 for the conversion to occur, and the post-conditions specify the conditions to be satisfied after the conversion:

$$\text{cell}_{ps-1} = \arg \max_n \left(\sum_{m=1}^M P_{f-n_m} \right) \quad (4)$$

The functions, behaviors and structures obtained from the transformation are checked for correctness F by a computer to judge whether the transformed N meets the constraints in the target meta-model:

$$\text{cell}_{ps-n_s} = \arg \max_{n, n \neq \text{cell}_{ps-1}, \dots, \text{cell}_{ps-(n_s-1)}} \left(\sum_{m=1}^M P_{f-n_m} \right) \quad (5)$$

Using the element implication of the design object, the product scheme design process $m=1$ can be inferred layer by layer to generate the implication extension set m :

$$\text{cell}_{ps-n_{s1}} = \arg \min_{i, i \neq \text{cell}_{ps-1}, \dots, \text{cell}_{ps-n_s}} \left(\sum_{m=1}^M \sum_{l=1}^M p_{li} \|h_{i,ps-1}^T w_{i,i_l}\|_2^2 \right) \quad (6)$$

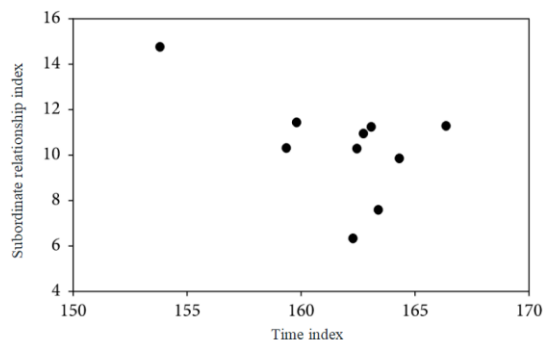
$$R_{n_i}^C = \log_2 \left(1 + \frac{p_{mac,n_i} \|h_{mac,n_i}^T w_{mac,n_i}\|_2^2}{\sigma^2} \right) \quad (7)$$

perceptions. The meta-model adopts a unified description and expression method, which makes it widely reusable, easy to share and interoperate, and can easily realize the integration, sharing, query, reading and interoperability of the subject data model. Through many opposing factors to achieve the beauty of visual contrast. In the aesthetic design of daily-use ceramics products, the designer also emphasizes the beauty of personality by comparing the elements of gravity, space, existence and nonexistence, emptiness and reality, giving people a strong and distinct feeling, reflecting the contradictory and unified world outlook in philosophy. Therefore, on the one hand, the design of daily-use ceramics must adapt to the development law of modern social science, technology, economy and cultural life, on the other hand, it must attach importance to both the material needs of human beings and the spiritual needs of human beings in the design. Another important concern in the design of daily ceramic products is the emotional needs of consumers, which can be divided into two aspects, namely, cultural background and personal experience. When designing Japanese ceramics, it is possible to integrate them with history and culture by reactivating the traditional production process. The extension of elementary elements is used to expand elementary elements, and then the expanded results are screened based on extension rules and evaluation criteria, thus converging into a small number of elementary elements. This divergent-convergent thinking method is called first-order rhombus thinking method. A set of affine relationships represents the relationships among various design objects, design semantics, and meta-model components. The dependency relationships of meta-model components are shown in Figure 6.

Metamodel Transformation

The emotional elements of ceramic decoration lie in making full use of all kinds of decorative elements to produce a pleasant organizational form suitable for the senses, so this kind of person's sensibility should be considered in decorative design. Material and technology should be brought into full play accurately. Combining the strengthening and embellishment of decoration, it is a multi-level intuitive understanding of visual effects. It is neither a complete existence of consciousness nor a pure unconsciousness, but a psychological reflection of a variety of visual

Figure 6
Component Relationship Subordination of Metamodel



Judging whether the target model RSRP obtained after instantiation meets the discipline analysis requirements, and if so, obtaining the target discipline model:

$$RSRP_{n_i,n}(\lambda_j - \lambda_R) = RSRP_{n_i,m} \quad (8)$$

Using the elementary implication U of the design object, we can make layer-by-layer reasoning T on the design process of the product scheme to generate the implication extension set:

$$l^2 = \frac{4\varepsilon_0 U_0}{9eZN_i} \left[\sqrt{\left(1 + \frac{u(t)}{U_0}\right)^3 + \frac{3u(t)}{U_0}} - 1 \right] \quad (9)$$

$$N_i = N_{i0} \exp\left(-\frac{t-t_0}{\tau}\right) \left(\frac{D_{amp} l^2}{D_{gap}^2} + 1\right) \quad (10)$$

The extension of elementary element is also applicable to composite element, then the extension reuse degree dt of composite element is based on the formula:

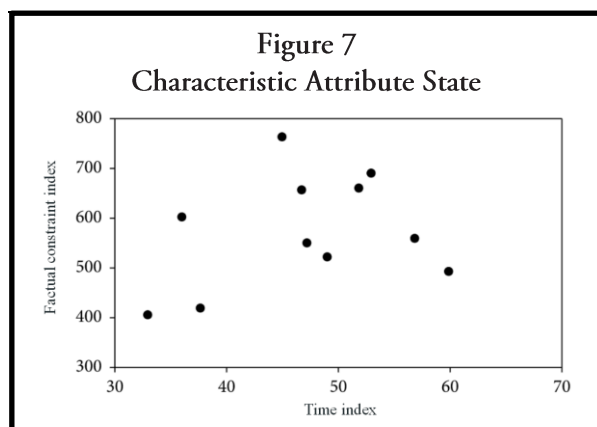
$$U_0 = \frac{M_i}{2e} \left(v_i + \frac{dl}{dt}\right)^2 \quad (11)$$

Starting from one primitive, the same object and feature primitive D, the same object primitive Z, the same feature primitive N, the same feature primitive E and the same magnitude primitive I can be expanded according to the formula:

$$i(t) = \frac{\pi D^2 Z N_i e}{4} \left(v_i + \frac{dl}{dt}\right) \quad (12)$$

Product design is a process of repeated modification and gradual refinement. After the product design project is determined, the project should be first decomposed into a series of subprojects and tasks in combination with

the product BOM. Emotional design should use the ideas and methods of interactive design to make people communicate with products like friends, to put people and products on an equal footing, and to attach importance to emotional interaction in the use process to increase users' goodwill. There are specific design directions and design fields. In the process of reusing the existing design knowledge, it is not necessary to expand all the knowledge. Therefore, it is necessary to restrict and restrict the expansion of the basic elements of the design objects in the product scheme design. The design meta-model should not only represent the information of product design semantics, physical structure, relations and constraints, but also support the dynamic expansion of product information model. The status of feature attributes is shown in Figure 7. Focusing on people's inner emotional needs and spiritual needs, the design concept runs through the design of products to create pleasant and moving products. This affinity product can make people enjoy the inner happy aesthetic experience and make life full of fun and moving. The designer of daily-use porcelain with emotional appeal exerts great efforts to express some humour and interest through its shape characteristics, so that users can feel freshness and pleasure in the process of using it, and then can show the process of using it to the bystanders, and get double satisfactory evaluation from their own operators and bystanders. Integrating the design concept into daily-use ceramics, the meaning of green, fun and so on, constantly sublimates consumers' life experience. Creating artistic patterns with unique aesthetic experience, patterns are part of the daily-use porcelain shape and indispensable to reflect the beauty of the form of daily-use porcelain.



DISCUSSION

In this paper, the emotional expression of meta-model design of daily-use ceramics products is studied. Facing the diversified choice of ceramics products for daily use, paying for emotional needs has become the main trend of consumption. With the progress of the times, the complexity and comprehensiveness of design have become increasingly prominent. Every ring binding in ceramic design should be balanced rationally and sensibly. On the premise of giving full play to the function and utility of ceramic products, the user's emotional needs should be met by various artistic means to the greatest extent. On the basis of traditional patterns, daily-use ceramics products also pay attention to the change of patterns' shape, and take the patterns with changeable and hierarchical sense and colorful composition as an important way of emotional expression. Under meta-model, information objects are obtained by extracting the characteristic attributes of project management information and product design information, reflecting the relationship between information entities. However, knowledge objects are obtained by correlating related information objects, which reflects the improvement made by the accumulation of tacit knowledge after deeply exploring people's internal needs, changes the situation of "technology decides design" in the market, can undoubtedly greatly enhance the added value of brands and products, and reflects the ultimate concern of designers for human beings, thus having a wide range of development space. The ever-changing aesthetic taste of the public and the pursuit of quality of life have brought more daily ceramic products that make people happy and touched,

making these products resonate in the spiritual level during use and improving the affinity of the products.

Human Subjects Approval Statement

This paper did not include human subjects.

Conflict of Interest Disclosure Statement

None declared.

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