

A Research on the Ceramic Tea Set Design Based on Ergonomics

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Abstract: Tea culture is an important part of Chinese traditional culture. As the main appliance of drinking tea, ceramic tea sets have become one of the necessities of people's daily life after thousands of years of design and development, and are closely related to people's life. In the context of diversified development, tea sets not only need to meet people's needs of drinking tea, but also pay more attention to physical and psychological feelings. Tea sets need to meet the needs of modern material and spiritual civilization in more and other aspects. This paper takes the ceramic tea sets as the research object, combined with the relevant theory of ergonomics, systematically discusses the composition and function of the human-machine interaction interface of the ceramic tea sets, and expounds from the perspective of human use habits, hand physiological characteristics and the influence of use safety on the shape of the tea set. From the perspective of people's psychological feelings, the human psychological characteristics and its influence on the color and shape of ceramic tea sets are studied, so as to provide guidance for the design of ceramic tea sets.


1 INTRODUCTION

As one of the important components of Chinese traditional culture, tea culture is closely related to people's daily life, forming a distinctive style of the times. Tea set is an important material product among Chinese ceramic varieties, as well as the spiritual wealth of Chinese culture, which perfectly reflects the integration of science and technology and aesthetic art. The development of social economy, the progress of science and technology, the promotion of culture and art, the change of times and customs, and the change of aesthetic concepts in the past dynasties are reflected in the plastic arts of tea sets, which makes it not only have the unique national style of the Chinese nation, but also have a strong sense of the times and distinctive artistic characteristics(Wu,2013).Today, tea drinking has become a fashion to eliminate fatigue, enhance friendship, improve the artistic accomplishment of the host and guest, and cultivate the temperament of the host and guest. It reflects the leisure, elegance and optimism of people who love life.

Tea set, as a daily necessities, although it has very beautiful decoration, is more often used as an instrument for entertaining guests than simply as a work of art. Therefore, the design of ceramic tea set should put its practicality first. In the hundreds of years of design process, the shape of the tea set has been basically fixed. The designers are more interested in the design of tea set decoration, that is, the design of painting on the surface of the whole set of tea sets, which simply meets the aesthetic needs of users. Even if there is a design that changes the type, it is also to pursue the artistic effect it conveys. These designs ignore the practicality of the tea set as a tool for daily life, Neglected the interactive relationship between tea sets and people, and ignored the concern for human nature. At present, the progress in science and technology is changing with each passing day(Yang and Wang,2015). Many new things and technologies emerge one after another. With the overwhelming supply of products in the market exceeding the demand, the market competition has entered a white hot stage. Most enterprises in China realize that products are ultimately used by people

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and made for people. The degree of consumer demand for products is the key to the survival of enterprises. Comfort has become one of the main factors affecting product sales. Especially with the continuous improvement of material and cultural level, people's requirements for products are not only the beauty of appearance and the realization of functions, but also the physiological and psychological feelings.

The people-oriented principle advocated by interaction design has brought high added value and favorable position in the competition to products, so more and more enterprises begin to pay attention to interaction design. Interaction design uses the research results and methods of various disciplines such as ergonomics, human physiology and psychology, anthropometry and social science to study various characteristics of human physiology and psychology and their impact on human behavior. It plays an important and special guiding role in the production and development of best-selling products. Interaction design emphasizes the coexistence of users and product use environments, as well as the construction of interaction places and spaces. It requires users to feel an experience brought by two-way information exchange between people and products during the use of products. Interaction design focuses on how to design products that meet users' needs. It is committed to understanding target users and their expectations, and understanding each other's behavior when users interact with products. Understand people's psychological and behavioral characteristics.

2 RELATED WORK

As a kind of daily necessities, tea sets should fully study various problems that people may encounter in the use process, and consider the interaction between the use and being used of tea sets. In the shape of tea sets, there are three main factors: functional effectiveness, material technology and form aesthetics. Ceramic tea set, as a kind of daily use ceramic, its function and utility should be put in the first place (Yu, 20115). It should make full use of industrial production materials and technologies to create a unique formal aesthetic sense of the shape of the utensil on the premise of meeting the use requirements. The tea set with reasonable function provides convenience for people's life, but it will naturally cause psychological pleasure. The shape of this utensil contains a rational formal beauty.

In the modeling design of tea sets, it is difficult to improve and create the function and utility, which is far more difficult than the renovation of patterns. It is necessary to break through the thinking set of traditional tea set modeling design. According to scientific principles, we should start from the actual needs of life to think about the design problems. We should not be bound by the existing form and structure, highlight the rationality of the modeling, and give better play to the practical functions of tea sets. If a tea set cannot meet its basic functional requirements, no matter how the shape changes, it cannot achieve the maximum life cycle. In the process of tea set design, the creation of new types and the improvement of products are all aimed at facilitating people's use. The first consideration should be functionality and reliability. Human factors should be added to the tea set design as a technology. Humanized design elements should be added to make innovation based on full satisfaction of various design constraints, reflecting the concern for human nature. This technology can create products in the human field and better serve people.

Diversification is the symbol of our time. It enriches people's spiritual life and brings infinite reverie and fun to people's life. Some tea sets only pay attention to the diversification aspect in the development, ignoring the rationalization aspect of the product, which brings many inconvenience and regret to people's life (Zhang, 2016). In order to further adapt to the market demand of diversified and high-quality commodities in modern society, it is necessary to re-examine the relationship between the design elements of ceramic tea sets in order to achieve perfect quality of products and improve the competitiveness of products. Now the rapid development of technology has already turned to people-centered design, and the main difficulty of design has changed to how to find the most appropriate relationship between people and products, and how to study the degree to which the product structure and "human factors" want to fit. Designers began to change the focus of design. Design is no longer simply to make products more beautiful. More design focuses on making products more in line with people's needs. Tea set is closely related to people's daily life. Modern people's demand for tea set is not only to meet their basic needs for drinking tea, but also to have more connotation to meet people's material and spiritual needs.

Ceramic tea sets have certain potential safety hazards in the use process because of their own materials and use environment. For example, ceramic itself is a very fragile material. Broken ceramics will harm people's body shape. The whole use process of tea sets is related to boiling water. Some bad designs are easy to burn people or people break the tea sets

because of burning(Zhang,2015). Therefore, in the design process of ceramic tea sets, It is necessary to take into account the inconvenience or injury of modeling due to people's natural tendency, and use the strength of designers to avoid these injuries. Because human behavior habits and ways are a kind of natural tendency that is not easy to change formed in the long-term evolution process, following human natural tendency can reduce such man-made defects and hidden dangers to a certain extent, greatly improve the safety and practicality in product design, thus making the use of products more efficient, comfortable and safe.

The interaction between tea sets and people is realized through human vision and touch. The first thing to exchange information with people is the shape and color of tea sets. It makes an impression in the human brain by stimulating the human visual nerve(Guo and Liu,2020). The human brain reacts to the received information, thus forming a unique psychological feeling, that is, the first feeling of the tea sets that people contact, At this time, the interface between people and the tea set is all over the tea set, and people can see all aspects, including some very small places, which can make people have different psychological feelings, because relatively speaking, people's visual feelings are the most sensitive.

3 TEA SET DESIGN BASED ON HUMAN BEHAVIOR

Some basic principles should be followed in the design of objects in contact with hands: first, muscle static load should be avoided as far as possible. If the arm must be raised when using tools, the shoulder, arm and hand muscles will bear static load, which will lead to fatigue. During the design of the handle, the arm should be kept in a more natural horizontal state during the operation, so as to reduce the static muscle load generated by lifting the arm. Secondly, the wrist should be kept straight, so as to ensure that any force applied to the hand will not produce the moment of rotation around the wrist when it is transferred to the arm. When the wrist is straight, the wrist joint is in the middle of the relaxed state. Other states will make the wrist ache, resulting in reduced grip strength. Finally, in order to ensure safety and avoid injury, the use of the product should ensure that the force is applied to the non vulnerable parts of the hand, including soft areas such as knuckles, under the thumb and thick muscles below the fifth finger.

In the whole set of tea sets, the teapot is the main appliance for making tea. It is composed of the body, mouth, feet, lid and handle. The parts most in contact

with the hands are the lid and handle. The pot handle plays the role of carrying the pot. It is required to be stable, labor-saving, not slippery, not hot, proper size, reasonable installation position, and convenient for tea pouring. The bonding part of the handle should be slightly lower than the lower part of the spout, so as to maintain coordination and balance. The general handle is installed in the middle of the pot body, and the low flat handle is installed in the upper middle part. The neutral width of the handle should be appropriate. If the handle is too narrow, it will be hot to handle; If it is too wide, the center of gravity of the pot deviates and it is hard to carry it. In general, the distance from the handle to the body is generally not more than the maximum radius of the body.

Different sizes of teapots can be grabbed in different ways. For small teapots, the thumb is usually used to press the top of the lid, the index finger goes through the handle, and other fingers hold the bottom of the pot to pick it up. For this kind of pot, a concave plane can be designed on the top of the teapot cover to facilitate thumb pressing. For a pot that can only be grasped by the handle, the handle should be designed to keep the wrist straight during grasping, so that the hand is in the most comfortable state. The most comfortable hand holding state is to keep the handle of the teapot at a 10 degree bending angle with the base of the thumb (see fig.1).



Figure 1: Ceramic teapot handle.

The wrist should be kept as straight as possible to reduce the pressure on the wrist when the hand is being held. Tea is brewed with freshly boiled water. Heat insulation protrusions shall be set at the contact part of the pot body and fingers to form a heat insulation space between the fingers and the pot body to prevent fingers from being scalded(Wang,2021). This protrusion can use special patterns to meet the needs of modeling design. The tea cup matched with the tea set is generally small, without a handle, and the hand fully contacts the cup body in the process of grasping, so it is more important to prevent slipping and scalding. With the continuous improvement of firing technology, double-layer ceramics have emerged, which is a good solution to the needs of anti scalding.

The design of the lid should meet one of the most basic functions: the lid cannot fall off during pouring. This has certain requirements for the internal structure of the lid opening. Physically, it is necessary to ensure that the center of gravity of the lid is always at the side of the geometric center close to the handle during the dumping process, so that no torque towards the spout will be generated (Yin,2018). Therefore, the lid button of the lid cannot be too large or too high, which will cause the center of gravity of the entire lid to lean up. In this respect, the famous "Gropius Tea Set" does a very good job(fig.2). Its cover button is close to the eaves on the side of the handle of the pot, and is consistent with the handle in shape. When pouring water, people can naturally press their thumbs against the cover button to prevent it from slipping. It is often adopted to install triangular porcelain teeth or lengthen the mouth of the lid at the lower end of the lid opening. In addition, a small hole is usually drilled on the lid, so that air can pass through the hole. When the lid is covered, water will not overflow from the spout due to the pressure of air. At the same time, due to the air circulation, the water will flow smoothly.



Figure 2: Walter Gropius tea set.

For the spout, first of all, it is necessary to ensure that the spout can flow freely during use, without water spraying, dripping, sprinkling and salivation, which are related to the angle, shape, length and opening shape of the spout. The water outlet angle of the spout cannot be too large or too small. Too large water outlet angle will cause the spout to deform during the firing process. Too small water outlet angle will make the spout not flow smoothly and will cause water dripping and leakage at the same time. The water outlet angle shall be determined according to the height of the pot. The water outlet angle of the high type pot shall be smaller, while the water outlet angle of the low type pot shall be larger. The water outlet angle of the spout is generally designed to be about 40 degrees(Chen,2018). The shape of the spout shall adopt the shape of bending and turning as far as possible, which can not only coordinate the shape

relationship and balance relationship with the kettle body, but also play a role in regulating the speed of water outflow. The root of the spout should gradually decrease towards the spout mouth, so that the pressure of the kettle when it is tilted for water injection will gradually increase, and the water will be full and powerful. If the water outlet surface of the spout is larger than the cross section surface of the neck of the spout, water sprinkling will occur. The opening of the spout is mostly shaped like a melon seed. The small part is at the bottom, and the thickness of the spout outlet is slightly reduced. The shape of the lower lip of the spout is appropriately treated as a downward overturned structure, so that the flow can be controlled more accurately when pouring water. At the same time, the water cutoff area is small when collecting water, and there is not much water on the cross section of the spout to avoid salivation.

As the supporting facilities of the tea set, the cup mouth should be smooth and round, the mouth edge should be slightly open, and should not be very thin, so that the lips can get a better sense of contact. The shape of the cup mouth should be reasonable. If the cup mouth is too open, the tea will overflow along the mouth corner when drinking tea. If the cup is too much, it will touch the nose when drinking tea, which is not easy to drink clean, and it is easy to accumulate tea stains, which is not suitable for cleaning(Liu and Chen,2020). The shape of "Deng cao kou", a traditional Chinese utensil, gives a thick and round feeling(see fig.3). The outward opening edge can give a good sense of contact with the mouth, and can also meet the requirements of anti scalding. After the tea cup is used up, in order to keep it clean and sanitary, it is generally buckled upside down on the tray, which requires that the height of the cup handle should not exceed the cup mouth.



Figure 3: Deng cao kou tea cup.

4 TEA SET DESIGN BASED ON HUMAN PSYCHOLOGICAL

The influence of psychological feelings on the shape of tea sets is shown in many different aspects, and each aspect has its own characteristics. It is necessary

to study the relationship between the shape of tea sets and people's psychological feelings from various aspects.

The continuous change of the shape and part of the ceramic tea set modeling is a common means(Ding,2017). Because a basic form of change appears repeatedly, forming rhythm, the overall modeling has a sense of rhythm. This rhythm can be expressed in the vertical shape of the tea set modeling, but also in the plane shape of the modeling. The repeated appearance of one basic form forms a relatively simple rhythm, and the repeated appearance of more than two basic forms forms a relatively rich rhythm. The artistic effects of the two forms have their own characteristics(see fig.4). In dealing with the longitudinal relationship of the overall shape of ceramic tea sets, the method of gradual change is often used. A part of the shape changes from bottom to top, decreasing or increasing. Each segment is similar in shape, different in volume, and stacked together to form a whole shape, showing a gradual change relationship. This change mode makes the overall shape more visual impact, and the sense of hierarchy more distinct. Sometimes, in order to pursue a more unique sense of rhythm, the tea set will be divided into different sections with different heights, widths and shapes(Liang,2017). The conscious arrangement of the connections between the sections can form regular changes and enhance the sense of rhythm of its shape.



Figure 4. Fish scale teapot.

Ceramics are fragile materials. Tea sets made of ceramics should give people a sense of stability, ease of movement, and not easy to break. People are not used to the shape that can not be placed stably and stand easily, which is easy to knock down. This shape is easy to cause psychological anxiety. This requires that the center of gravity of the whole tea set should be reduced, and the main weight of the shape should be less than one third of the overall size; Secondly, the overall shape of the tea set should be spherical. If one side is high and the other side is low, it is unbalanced, giving a sense of instability; Finally, the size proportion of the sole surface is appropriate, the diameter of the sole increases, and the stability of the shape also increases(He,2022). Generally, the intersection of the parallel lines at both ends of the

upper shoulder and the diagonal lines at both ends of the sole should be higher than one third of the overall height. In the design process, we should also avoid some unsafe and uncomfortable feelings caused by the inherent visual rules of the overall shape proportion of the tea set(Han,2017). For example, for a large pot, its handle should not be designed very thin. Although the strength of the handle is enough to support the weight of the whole pot filled with water, people will unconsciously worry when using such a pot.

The shape of tea set is a dynamic shape, which contains a kind of spirit and implication. It emphasizes that the overall shape is integrated from top to bottom, and the shape is undulating and coherent, showing a complete situation. In the process of modeling design of tea sets, if we do not study the spirit atmosphere that the overall modeling is displayed outside the shape and contained inside the shape, the whole modeling will lack charisma, make people feel cold, stiff and boring, and cannot cause emotional resonance between users and designers(Huang,2016). This passion is reflected in the strength and charm of the tea set modeling. The strength is used to explain and express a visual feeling of the tea set, so that people can feel the expression of strength. Only the tea set with strength and charm is beautiful, can it have "life", the sense of quantity of the body can be clear, and the form features can be prominent, thus strengthening the formal beauty of the modeling. The tea sets with different modeling styles will give people different sense of strength. Some obviously feel a kind of expansion, and some calmly present a state of freedom. The rough tea set modeling requires a strong and powerful feeling, the elegant tea set modeling requires a straight and beautiful feeling, and the more subtle and soft tea set modeling requires an internal force, so that it can be soft with strong, lively, and avoid paralysis and depression.

The sense of strength in the modeling of tea sets is the result of a kind of latent consciousness formed in the process of long-term observation and understanding of objective things, which is basically consistent with the mechanical principle of objective things(Yang and Wu,2015). The sense of strength of the modeling is mainly expressed through the contour lines on both sides of the body. The simplest cylindrical modeling, because the contour lines on the facade are vertical, shows a supporting force, and to a certain extent, shows a straight upward force. If the shape of the cylinder is changed, so that the contour lines on one side are vertical and the contour lines on the other side are inclined, the force performance will change, On the inclined side, there will be an inward pushing force, which will create a visual sense of imbalance. The greater the angle of inclination, the

stronger the feeling. If the contour lines on both sides of the shape are in the form of upward contracting trapezoid, it will feel pulled up and contracted. If it is in the form of downward contracting trapezoid, it will feel like an upward expanding tension.

In the process of modeling design of tea sets, if you want to obtain a full and substantial modeling shape, it is mainly to strengthen the expression of expanding tension from inside to outside, and at the same time, set off the local contraction force to enhance the expansion strength, so that the entire modeling will leave a more profound and clear impression on the vision. According to the different expansion and contraction proportions, sizes and positions, a variety of psychological feelings will be generated, and the aesthetic feeling of the form of the modeling will also have a variety of changes. These changes are determined by the positions of the strongest points of the expansion and contraction forces. Some of these strongest points are in the middle of the modeling, decreasing upward and downward, giving a feeling of roundness of the shape, and some of the strongest points are in the lower part of the shape, It gives people a sense of thickness and stability. Some of the strongest points are in the upper part of the body, giving people a sense of slender and straight. In the design process of tea set modeling, we should consciously integrate the strength into the form to increase the connotation of ceramic modeling design.

5 CONCLUSIONS

This paper mainly analyzes the development process and design status of ceramic tea set, the use mode, physiological characteristics, psychological characteristics and use habits of tea set users, as well as the study and research of interaction design theory, and analyzes the problems in ceramic tea set design and the form and interface of information interaction between tea set and people, On this basis, the design of tea sets is analyzed from the aspects of use behavior and psychological feelings. In terms of use behavior, this paper analyzes the characteristics of people's tactile perception, the use behavior of tea sets and the physiological characteristics of people, discusses how the shape of tea sets can meet people's use needs, how to make people use tea sets more safely and comfortably, and puts forward practical and feasible solutions. In terms of psychological feelings, this paper analyzes in detail the influence of people's psychological characteristics and habits on the color and shape of tea sets, expounds what kind of psychological feelings each color and shape gives people, and how to make the color and shape of tea

sets better meet people's spiritual and civilized needs, so as to guide the design of ceramic tea sets.

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