

Research on the Design of Pet Cat Soothing Toys Based on Emotionalization

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Abstract: *Background:* Pet cats' role as family members has been increasing due to the accelerated pace of modern life, resulting in significant growth in the pet cat toy market. *Purpose:* This study aims to explore the problems associated with existing pet cat toy balls, with the goal of providing safer, healthier and more engaging toy balls for pet cats. It aims to provide pet owners with a more enjoyable environment for human-pet interaction, and to improve the quality of life for both humans and their pets. *Methods:* The study explores the behavioral habits, emotional and psychological needs of pet cats by means of literature survey, case analysis and comparative study, resulting in the proposal of a series of design principles and elements. The study indicates that the design of emotional toys for cats should focus on sensory stimulation, safety, durability, cleanliness and innovation. The design case studies cover emotional soothing toys from Japan, Europe, America, Korea and China, demonstrating design concepts from different cultural contexts. *Results:* The study proposes a new pet cat soothing toy ball design that combines the characteristics of cat nature and human cervical membrane massage ball, which considers safety, durability, interactivity, and is implemented using silicone mold one-piece technology. Design optimization and iteration further enriched the diversity and appeal of the toys to suit pet cats of different sizes and preferences. *Conclusion:* The study concluded that the pet cat soothing toy ball design not only meets the demands of pet owners for high-quality pet products but also strengthens the emotional connection between pet cats and their owners through emotional design, and improves the quality of life of the pets. The optimization and iteration of the design demonstrates the sustainable development potential of the product, introduces a new innovative direction, and anticipates a wide range of applications of emotional design within the field of pet supplies industry.

Keywords: Emotional Design; Pet Cats; Soothing Toys; Function Balls; Product Design

1. Introduction

1.1 Research Background

As the pace of modern life accelerates, more and more people are choosing to adopt pets to relieve stress and loneliness. This underscores the significance of the quality of life for pet cats as integral member of the family. China's report at the 20th Party Congress emphasized the importance of promoting and establishing a global community of life, in which the harmonious coexistence of man and nature is crucial. The China Association for the Care of Pets advocates respecting the natural behavior of pets and improving their quality of life by promoting a balanced relationship between humans and pets. According to the "2023-2024 China Pet Industry White Paper" released by Have Pet Research Institute indicates that the urban pet consumption market for dogs and cats in 2023 will reach 279.3 billion yuan in 2023, reflecting an increase of 3.2% over 2022, and the number of pet cats will be 69.8 million, an increase of 6.8% over 2022 respectively. As one of the core categories in the pet industry, pet cat toy balls are

contributing to the steady development of pet toy market. In 2022, consumer demand for soothing toys intended for use by dogs and cats accounted for 29% and 27% of the market, respectively, a figure that far exceeds that of snacks, collars, apparel, and other traditionally more popular pet supply categories. This phenomenon reflects pet owners' growing concern for their pets' psychological and emotional needs, and their willingness to invest more resources to enhance their pets' well-being. This trend has not only reshaped the pet product market, but also highlighted the importance of emotional design in the pet product sector, driving the transition of pet product design from functional to emotional satisfaction. Based on the continuous and steady growth of the pet cat toy market scale, this study analyzes the design principles and strategies in light of soothing toy design needs in pet cat psychology.

1.2 Research Objective

The aim of this study is to explore the problems associated with existing pet cat toy balls and identify areas for improvement. By investigating at how pet cats' already use toy balls, we will understand their preferences, how they play with them, and the potential effects on their health and behavior. We can also combine pet cat toy balls with soothing toys. Furthermore, this study will also analyze the existing problems in the design, material and quality of pet cat toy balls, combine them with emotional design and propose corresponding design solutions. To provide pet cats with safer, healthier and more interesting toy balls, to provide pet owners with a more pleasant environment for human-pet interaction, and to improve the quality of life of people and pets together.

1.3 Research Methods

Literature survey method involves the collection of knowledge network literature and pet cat soothing toy ball related books and other literature. Screening the collected literature, eliminating the literature that is irrelevant to the research topic or of low quality, and retaining the literature with high reference value. Ensure the authenticity and reliability of the literature, and combine it with other research methods to obtain comprehensive information, extract key information, and analyze the product characteristics, consumer demand, and effect evaluation of pet cat soothing toy ball.

Case study method includes choosing several representative pet cat soothing toy balls as the object of analysis. Each case is thoroughly analyzed to explore its design principles, strategies and reasons for success or failure. By comparing and analyzing several cases, key strategies and principles of pet cat soothing toy ball design are refined. Apply the refined design strategies and principles to new pet cat soothing toy ball designs, and verify their effectiveness and feasibility through reflection and summary.

Comparative research method refers to selecting several representative pet cat soothing toy balls available in the market as objects for comparison. Compare the design ideas, function definition, market feedback and other data and information relevant to each toy ball. Compare and analyze the similarities and differences of these toy balls in terms of design principles, emotional layout, interactivity, fun, and market adaptability. Determine key strategies and principles for designing pet cat soothing toy balls. Apply these strategies and principles to the design of new pet cat soothing toy balls, and evaluate their effectiveness and feasibility through research.

1.4 Research Content

Firstly, this study explores the design of pet cat toy ball from an emotional perspective. Based on the three design levels of instinctive, behavioral and reflective layers proposed by Norman in the book 'Emotional Design,' the emotional needs and behavioral characteristics of pet cats were thoroughly analyzed, and the emotional factors were integrated into the product's appearance, shape and functional interaction design. Secondly, in-depth research clarifies the importance of emotional design in pet

cat toy balls. Conduct a study on the emotional expression behavior of cats. Based on this study, develop a set of principles that will guide the design of emotional toys. Also examine existing cases of emotionalized soothing toys in Japan, Europe, America, Korea and China and evaluate their positive and negative aspects. Finally, this paper analyzes the design of pet cat toy balls based on the emotional design theory and aims to explore how to integrate it to the emotional needs of pet cats and propose innovative design strategies, so as to promote the emotional connection between pet cats and their owners and enhance their quality of life.

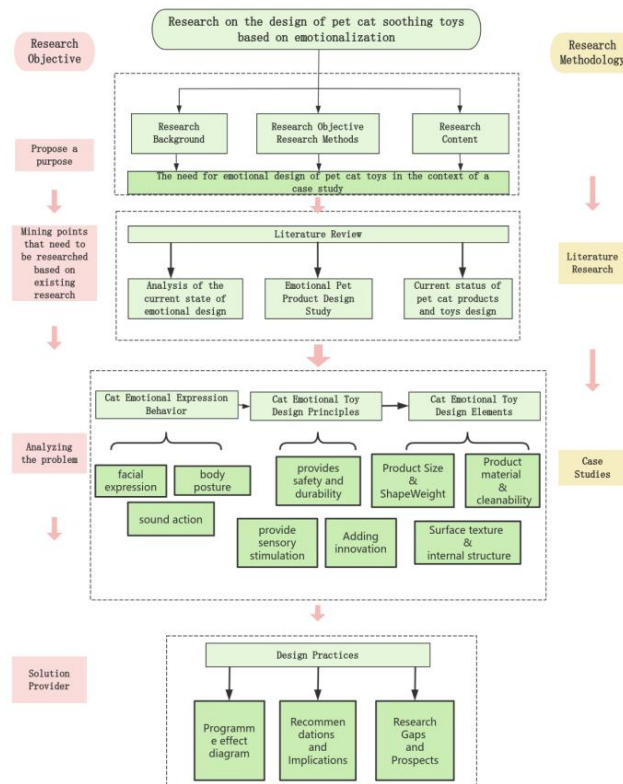


Figure 1: Frame diagram

2. Literature Review

An analytical study on the aspect of emotive design by Zhou et al. (2014), proposed that sensory and behavioral mnemonics work together to maximize the experience of awakening memories, triggering emotions and interactions between products and users. Eman Wu in 'A Design Approach Based on Emotional Design to Express the Meaning Embedded in Products' (Wu, 2024) proposes a specific approach in emotional design that synthesizes interaction design and ergonomics to make things more fun, add to the meaning of the product, improve user satisfaction, encourage emotional engagement, and connect with people on a deeper level. As shown in Figure 2, Donald A. Norman in 'Emotional Design' categorizes emotional design into three levels: Instinctive emotional mainly focuses on people's intuitive and instinctive response to things, i.e., through the visual, auditory, tactile, and other sensory experiences to attract the user's attention and interest; Behavioral emotional design pays more attention to the actual feeling and experience of users while using the product, ensuring the smoothness and reasonableness of user operation, so that users feel happy and comfortable in using the product; Reflective emotional design places more emphasis on the uniqueness and storytelling of the product and conveys a certain kind of value or emotion through the design of the product, so as to make users resonate with the product and have a sense of

identity, resulting in a profound user experience. 'Research on the Design of Fun Pet Products' summarizes the design method of human-pet shared furniture based on the concepts of fun, emotion, symbiosis, and provides a useful reference for the design of fun pet products. The design provides practical ideas and solutions to improve the symbiotic environment of pets and humans, promote the entertainment and interaction between pets and humans, reduce the loneliness, and improve the fun experience of both pets and humans (Ren,2024). The study of 'Emotional Demand-Oriented Design of Intelligent Pet Cat Feeder' summarizes the design process of intelligent pet feeders based on emotional design theory and applies it to intelligent pet feeder practice (Yang,2020). The analysis of the use of emotional hierarchy theory in emotional design shows how emotional design can be used in different products through case studies. It emphasizes the positive impact of emotional design on enhancing the user experience by looking at how the three levels of emotional design techniques can stimulate emotional interactions between the user and the product, and summarizes the ways in which emotional design can be used in product design (Liu,2024).

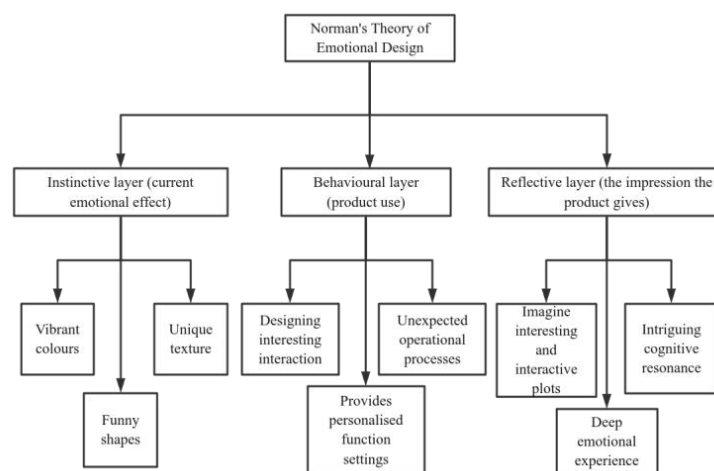


Figure 2: Norman's Three Levels of Emotional Design Theory

The study titled 'Exploration of Intelligent Product Design Based on Pet Dog Psychology' (Wan, 2024), analyzed the design principles and strategies of intelligent pet products. It concluded that the design of such products should address not only the basic physiological needs of pet dogs but also consider their psychological well-being to enhance the overall user experience. The 'Research on Intelligent Pet Dog Clothing Based on Emotional Feedback' conducted a clustering and comparative analysis of the physiological condition of pet dogs, indicating that clothing design based on emotional feedback can effectively analyze the emotional changes of pet dogs in different living environments. 'The Application of Emotional Design in Pet Intelligent Products' show that the emotional design of pet intelligent monitoring products is extremely important to improve user experience (Li, 2024). The study titled 'Research on Lamp Design Based on Emotional Concept--Taking Human-Pet Shared Lamps as an Example' explores the design of human-pet shared lamps from the perspective of emotional design. This approach aims to align the emotional demands of human and pet, enhance the user experience, increase the product warmth, and serve as a reference for related product design research (Huang, 2024). Research on the 'Design of Cat Table Based on Emotional Bionics' combines emotional design and structural bionic methods for cat table design through scenario analysis, and uses computer-aided design to demonstrate the concept, thereby providing design ideas and references to enhance the development and innovation of pet furniture (Ma, 2023). The 'Research on the Application of Parent and

Pet Clothing Patterns Based on Emotional Design' examines the design of clothing patterns for parents and pets, analyzing the design principles and innovative application methods of modern patterns through the theory of three levels of emotional design (Chen, 2023). The 'Research and Design of Pet Companion Products Based on Product Service System' summarizes the unsatisfied user values of the existing products, refines them into the user expectation element model and function model, forms the consumption cycle of the service and the iteration of the content, eliminates the waste associated with disposable of pet toys, and enhances the bond between people and pets to improve pet well-being (Wang,2019).

About the design of pet cat supplies and toys, 'Pet Products Design Based on Symbiosis Concept' is a new design concept that focuses on the health and happiness of pets while applying the symbiosis concept of interactive technology to product design in order to express the concepts of health, happiness, harmony, and science. To realize the 'pet-oriented' interaction between human beings and animals (Tian, 2024). 'Owner personality and the well-being of their cats share parallels with the parent-child relationship' reveals the vital role of animals in human society. The study emphasizes that the match between the personality traits of the keeper and the pet cat and its living environment has a significant impact on the cat's health and well-being. There is a psychological bond between humans and their pets similar to that of companionship and attachment, and psychology as a science enables a deeper understanding of this interaction. This enables us to not only better care for our pets, but also enhance the emotional connection with them, thereby promoting both their physical and mental health (Finka, 2019). After exploring the literature on cats, the authors of 'A Survey on the Current Status of Pet Cat Toy Design', discovered that cats have the ability to acquire skills through repetitive observation and differentiate colors through teaching. They also have a superior olfactory and auditory abilities. Thus, designers can make a design that can provide the users with a richer and more meaningful experience of interaction between human beings and their pets (Yang, 2015). 'Research on the Design of Intelligent Interactive Toys for Pet Cats Based on Pet Behavioral Language' combines the concepts of scientific and healthy human and pet lifestyles, and proposes to satisfy the needs of pet cats left alone at home to play games and exercise, providing a reference value and practical significance for research on the design of intelligent interactive toys for pet cats based on the pet's behavioral language (Xu, 2023). 'Research on the Design of Pet Dog Toys Based on Puzzles' strictly follows the design principles, taking the promotion of the development of puzzles and the healthy development of the body and mind of pet dogs as the root, and conducting research on the design of a series of pet dog puzzles on the basis of the selection of colors, the setting of materials, and the setting of sizes in accordance with the principles of ergonomics and compliance with the national safety standards (Zhang, 2018). 'Research on the Design of Pet Cat Toys Based on User Experience' analyzes breeders and pet cats, then summarizes the actual needs of users, and combines user experience with pet toys to make it more in line with users' needs.

Table 1: A review of research on the design of pet cat soothing toys based on emotionality

Research Direction	Reference	Trait
State of the Art in Emotional Design	The joint role of sensory and behavioral mnemonics; Enhancing the fun and substance of product interactions; The three dimensions of emotive design	In emotional design, the combined effect of sensory and behavioral mnemonics awakens the memory experience and promotes emotion and interaction between the product and the user.

Emotional Pet Product Design Study	Principles and Strategies of Smart Product Design for Pet Dogs; Smart Pet Dog Clothing Based on Emotional Feedback; Application of Emotional Design in Pet Smart Products	Pet product design should take into account the psychological aspects of pets, guide and shape the good character of pets, and design products that can effectively analyze the emotional changes of pets, meet the innovative needs of the pet market, and bring more fun to interact with pets.
Current status of pet cat products and toy design	Design of pet products based on the concept of symbiosis; Research on the relationship between pet cats and their keepers; Survey on the current situation of pet cat toy design	Focusing on the health and happiness of pets, applying the symbiotic concept of interactive technology to product design to achieve 'pet-centered'.

In summary, the research trend of emotional design in recent years shows that the pursuit of emotional resonance is common in both domestic and international design practice. However, the unique emotional needs of individual users are disregarded resulting in design solutions that make it challenging to completely satisfy the needs of the users for a personalized experience. For the design of pet toys, the use of co-design methods can effectively enhance the user's participation in the design process, and ensure that the emotional value of the design is compatible with the user's personalized needs. When designing pet toys, we should deeply reflect on the limitations and challenges of existing cat toys, and explore how to integrate the habits and characteristics of pet cats into the design of toys to promote the interaction between owners and cats. Currently, emotional pet product design has made progress in considering the physiological and psychological needs of pets, as well as strengthening the emotional connection between humans and pets through design, but it has not yet paid sufficient attention to the personalities and preferences of different pets. Therefore, more personalized and customized pet products should be developed in order to strengthen the emotional connection between humans and pets. In the field of pet cat products and toy design, existing products are still insufficient in terms of sensory stimulation. Pet toy design should fully combine the visual, auditory and olfactory characteristics of cats to create multi-sensory stimulation products. Through the use of diverse sounds, smells and textures, the sensory appeal of the toys can be enhanced, thus improving the interactive experience of pet cats.

3. Analysis of the emotional needs of cats

3.1 Cat Emotional Expression Behavior

Table 2: Meaning of habitual language in cats and its specific manifestations

Idiomatic Language Meaning	Concrete Expression	Idiomatic Language Meaning	Concrete Expression
Marking of territory	Rubbing paws, using head rubbing to mark territory	Avoiding natural enemies	Good at traversing narrow passages, preferring closed spaces such as cardboard boxes, and seeking security
Hunting instinct	Preference for small prey toys such as birds, rodents, insects, etc., e.g., rope, balls, and feathered items	Hidden tracks	Habit of covering up excretions to keep them hidden and clean
Stay alert	Tend to occupy higher ground to better observe and monitor their surroundings	Hide by day and come out at night	Daytime rest, nighttime activities

Through literature research and practical observation, we found that the habitual language of pet cats, a concept introduced by Charles Darwin in 1872, believes that humans and animals have common psychological emotions as stated in his article 'Expression of the Emotions in Man and Animals'. The habitual language of pet cats in this study has been classified as instinctive habits and hobby habits. Pet cats have diverse habits; scratching objects as a way of keeping their claws sharp and marking territory, as well as a means of communicating with their own kind. Pet cats are good at jumping and climbing and are particularly interested in moving objects. In addition, pet cats are born with the instinct to cover signs of defecation to prevent them from being tracked by other animals, and show their emotions in a variety of ways (Darwin, 1872). Facial expression is one of the most important ways for cats to express their emotions. When a cat is feeling happy, it will show a relaxed facial expression with eyes slightly closed and mouth corners upturned; while when a cat is feeling nervous or fearful, it will show a tense facial expression with eyes wide open and mouth tightly closed. Furthermore, cats will also express their emotions through pupil changes, such as pupil dilation for excitement and pupil narrowing for alertness. In addition to facial expressions, the cat's body posture is also an important way of expressing emotions. When the cat feels relaxed and comfortable, it will show a stretched body posture with its limbs stretched out and its tail held high; while when the cat feels tense or defensive, it will show a huddled body posture with its limbs tightened and its tail between its legs. In addition, cats will also express their emotions through the position of their ears, such as ears forward to indicate friendliness and ears back to indicate vigilance.

In short, the cat's movements are also one of the most important ways of expressing emotions. When a cat feels pleasure, it will show intimate movements, such as rubbing against objects and rolling over; while when a cat feels nervous or defensive, it will show aggressive movements, such as erecting its hair and opening its teeth and claws. In addition, cats will also express their emotions through tail movements, such as tail wagging for friendliness and tail erecting for alertness. Understanding these ways of emotional expression helps to better interact and communicate with cats, meet the needs and improve the quality of life.

3.2 Cat Emotional Toy Design Principles

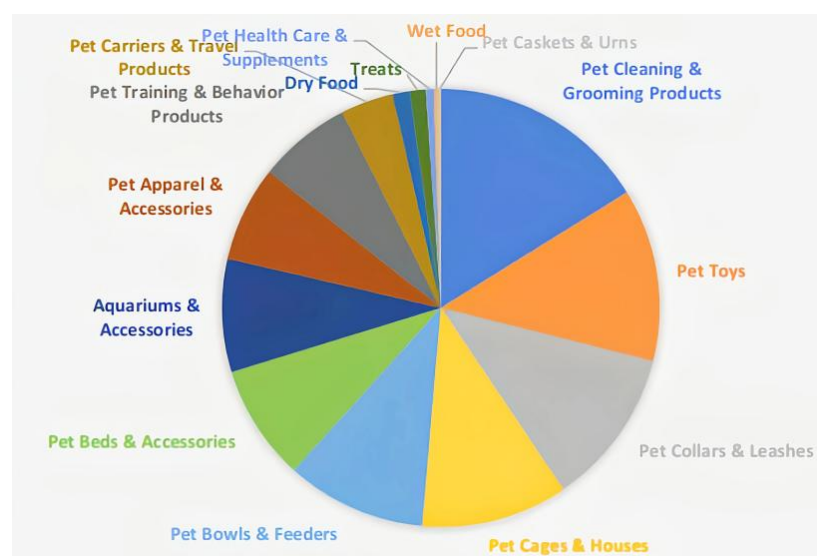


Figure 3: Pet industry traffic distribution

Source: Pai Read Pet Industry Big Data Platform

As shown in Figure 3, pet toys account for a high proportion of the pet industry, therefore there is a demand for toys for cats. Pet toy cats' design should fully integrate the sensory characteristics of cats, and provide diversified sensory stimuli to catch their attention, such as bright colors, bells that produce sounds, and smells that is appealing to cats to satisfy their curiosity and desire to explore. Meanwhile, considering that cats like to interact with their owners or other cats, the design should increase interactivity so that cats can feel more fun and connection while playing. Safety is one of the important principles of cat toy design. To ensure safety during play it is important to select a safe and harmless materials, and avoid designs that may harm them, such as small parts or sharp edges. Meanwhile, considering the natural hunter instinct of cats, the design should adapt to the nature of cats, such as toys that can simulate prey, so that cats can play to their hunting instincts and meet their hunting needs. In addition, cat toys need to be used frequently, so the design should choose durable materials or designs to avoid frequent replacement and save resources and costs. At the same time, cat toys need to be cleaned frequently, so the design and materials should consider the principle of easy cleaning in order to maintain the hygiene and service life of the toys.

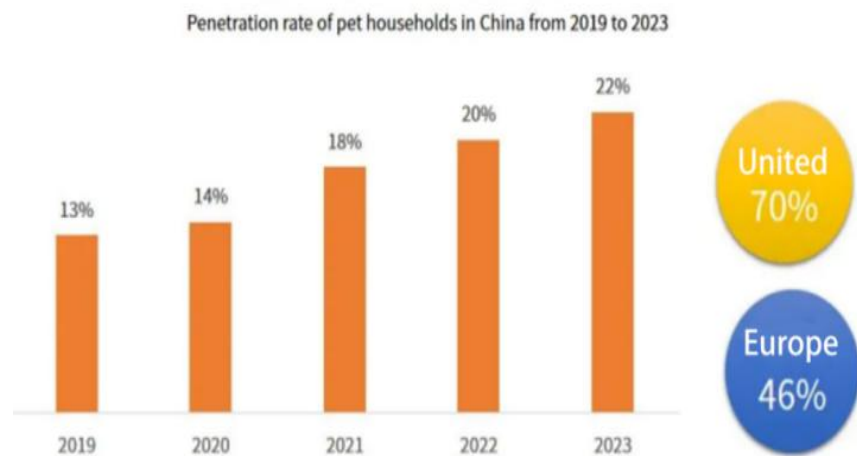


Figure 4: Research Report on the Development of Penetration rate of pet households

Source: Jingdong Data, ilmeedia Data Center (data.ilmeedia.cn)

3.3 Cat Emotional Toy Design Elements

Research on product size and shape has found that cats are more attracted to moving objects as they are more sensitive to them, and only ball objects have the greatest flexibility to roll around at will. The weight of the sphere is also an important consideration. It is important to find the suitable weight balance when designing the sphere. The surface texture of the sphere can affect the cat's grip and play experience. For example, a surface texture with bumps can increase friction and make it easier for cats to grip, while a smooth surface allows cats to chase and pounce better. The internal structure of the sphere can also affect its play and effectiveness. A sound device can be built into the ball to enhance the interaction of the toy. Silicone material is used, its softness and adjustable hardness adapt to different cats' needs, good elasticity and cushioning to protect cats' teeth and claws. Silicone can be dyed and printed with a variety of colors and patterns to attract cats. In addition, silicone is easy to clean and anti-static, making it easy to maintain hygiene and prolong the service life of the toy.

When designing emotional toys for cats, both the ball and the silicone material are important design elements. Through reasonable size, weight, surface texture, internal structure and softness, elasticity, colors and patterns, cleanliness and other considerations, you can design toys that are more in line with the nature and needs of cats. This will help cats grow and have happy lives.

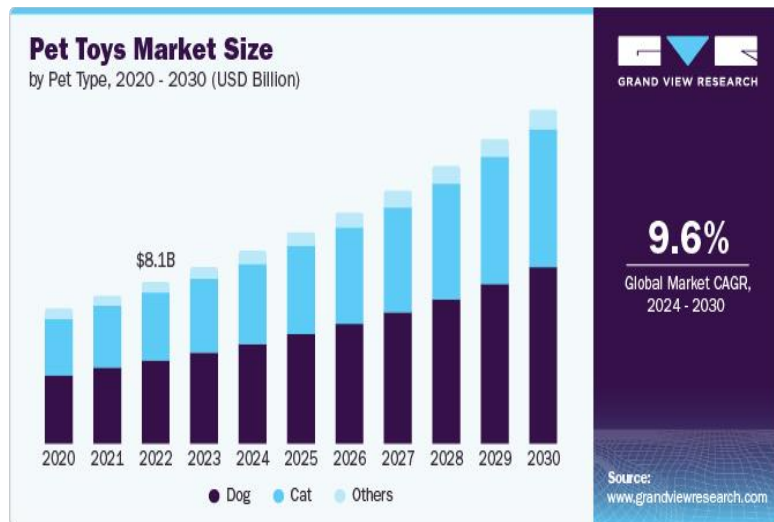


Figure 5: Research Report on the Development of Pet Toys Market Size

Source: www.grandviewresearch.com

3.4 Emotional Toy Design and Cat Soothing Behavior

As shown in Figure 5, the market demand for cat pet soothing products is increasing year by year. Cats are valued by their owners as family pets because of their ability to soothe and satisfy their emotional needs. To create toys that can arouse the cat's interest and also satisfy the cat's emotional needs, emotional toy design takes into account the cat's preferences, behavioral habits and psychological needs. These toys can stimulate the cat's curiosity, desire to explore and sense of satisfaction, and thus achieve a soothing effect during play. Emotional toys are designed to help distract cats from stress and anxiety by providing fun play experiences and interactive opportunities. When cats are immersed in the fun brought by the toys, they will temporarily forget their worries and feel relaxed and happy, thus achieving a soothing effect. Emotional toy design not only focuses on the individual needs of cats, but also on promoting emotional communication between cats and their owners. These toys are usually highly interactive, encouraging the owner and the cat to play together. During the interaction, the owner can give the cat attention, petting and rewards to enhance the emotional connection between them. This positive emotional exchange helps the cat to establish a sense of security and trust, further promoting the emergence of soothing behavior. Emotional toy design also focuses on cultivating positive behavior in cats. Through the design of reasonable toy structure and play, the cat is guided to engage in correct play activities, such as scratching, chasing, biting and chewing, etc., to exercise its physical coordination and intellectual development. Positive play activities also help cats to form optimistic and cheerful character traits and reduce the occurrence of undesirable behaviors.

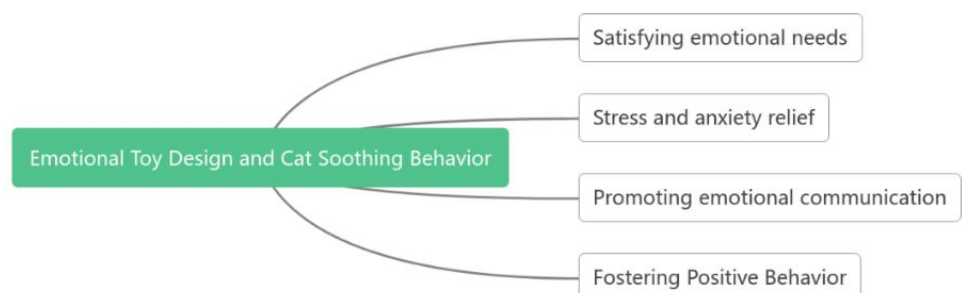


Figure 6: Emotional toy design and cat calming behavior

In conclusion, there is a close link between emotional toy design and cat pacification behavior. By meeting the cat's emotional needs, relieving stress and anxiety, promoting emotional communication and fostering positive behaviors, emotional toy design can effectively contribute to the production of cat pacifying behaviors.

4.Design Case Studies

4.1 Case Study of Emotional Soothing Toys in Japan

As shown in Figure 7, OurPets not only satisfy your pet's appetite (and prevent overeating), but also provide mental and physical stimulation by engaging in games that allow working for their food. With sliding and rotating compartments to hide pet snacks. Getting to these hidden snacks requires some problem solving, including figuring out how the components move to reveal the food hidden within. This provides mental stimulation for the pet to get food by scouting, strategizing and hunting like a wild animal.



Figure 7 Japan Emotional Soothing Toys OurPets Pet Feeder

Source: <https://www.cosmicpet.com/collections/ourpets>

4.2 Case Studies of Emotional Soothing Toys in Europe and America

As shown in Figure 8, the cat scratching board has a clean, streamlined design that blends with the modern home environment. The color and shape of the board are relatively low-profile and not too abrupt. It has sufficient hardness and abrasion resistance to meet the needs of cats for claw sharpening. Also provides a comfortable surface for cats to rest or play on. The cat scratching board is placed in the corner of the wall, saving space in the room and avoiding disruption to other furniture. The bottom of the cat scratching board has a non-slip design to ensure its stability and prevent your cat from pushing it over while using it. Due to the material and construction, this cat scratching board is easy to clean and maintain. From the cat's point of view, this cat scratching board provides enough height for the cat to stand comfortably and stretch out for claw grinding activities.



Figure 8 : European and American emotional soothing toys Art Scratcher

Source: <https://www.further.com/collections/art-scratcher-posts>

4.3 Korea Emotional Soothing Toys Case Study

As shown in Figure 9, Kim Studio's two-ring cat scratching board for Korean pet product brand Milliong is part of the Milliong Cat Furniture project, and together with the Tri-Pole Cat Tower, it makes a lovely picture. This creative piece of furniture not only serves as a cat scratching board, but also as a cozy rest/relaxation place for your cat. The product's two circular scratching boards are made of fabric and birch and appear to cleverly overlap each other when viewed from the front. The base platform and ledge above it hold the two scratches together, while also creating a cozy hollow space that provides an ideal place for your pet to laze and hang out. It is a truly cozy corner because the platform and ledge are both covered in faux fur.



Figure 9: Milliong Cat Scratching Board

Source: <https://en.milliong.co.kr/shopinfo/about.html>

4.4 Case Study of Emotional Soothing Toys in China

As shown in Figure 10, Triangle is a stylish pet toy that combines the elements of clouds, mountains and sunshine. Its triangular structure symbolizes the lofty mountains, while the rolling transparent ball represents the shining sunlight, and the cloud-shaped plate between the two signifies the lightweight clouds. When the pet touches the cloud-shaped plate, the transparent ball will roll along the track and release the snacks in it, bringing endless fun and surprises to the pet. This toy is not only unique in design, but also stimulates your pet's curiosity and desire to explore, making it a great companion for pet entertainment.



Figure 10: Triangle Pet Toys

Source: <https://zhuanlan.zhihu.com/p/677640189>

In summary, Japanese pet feeders satisfy pets' hunting instincts by providing mental and physical stimulation, but may be too complicated for some pets; European and American cat scratching boards are simple in design and space-saving, but have a single function; Korean cat scratching boards combine both resting and claw grinding functions, but may have space requirements; and Chinese toys are uniquely designed to

stimulate the desire to explore, but may be complex in structure. When designing emotional soothing toys, consideration should be given to the pet's behavioral habits, psychological needs and the interaction between the owner and the pet, as well as the practicality, ease of use and aesthetics of the product. Through continuous optimization and innovation, the needs of pets and pet owners can be better met.

5. Design Realization of Pet Cat Soothing Toy Ball

5.1 Design Sketch and Prototyping

Cats are naturally curious and have hunting instincts, thus the human fascia massage ball is a practical starting point for emotional design. The cervical membrane massage ball can be designed as a toy that can be rolled or shaken to attract the cat's attention and stimulate its hunting desire, then they will chase and attack the ball and release energy and stay active. Cats love to scratch objects to naturally sharpen claws and mark territory. Cervical Massage Balls can be designed with the appropriate hardness and flexibility to allow cats to scratch and bite while playing, satisfying their scratching needs. Originally designed to provide a soothing massage experience, the Neck Membrane Massage Ball can retain its massage function and through appropriate material and structural design, cats will enjoy the massage effect while playing, helping to relieve stress and relax muscles. During the design and manufacturing process it is necessary to ensure that the pet cat soothing toy ball is safe and harmless to cats, the use of food grade silicone and avoiding sharp edges or toxic materials is necessary. Cat toys need to have some durability to withstand the scratching and biting force of cats. The Pet Cat Soother Toy Ball is made of silicone and is rigorously tested to ensure its longevity. It can be used as a tool for interaction between cats and their owners. Owners can guide their cats to play and exercise by gently rolling or shaking the massaging ball. The inside of the toy ball is inlaid with bell-type sound-making devices to exercise the cat's reflexes. This interaction not only enhances the bond between the owner and the cat, but also keeps the cat energized and curious during play. In terms of modelling, it is prototyped with reference to the Pet Pixie Ball, borrowing the spherical design of the Pet Pixie Ball, which is easy for cats to grip and roll. Simple colors and striking red dividing lines are used to create a minimalist look. The ball has a split mechanism that opens and closes, with an embedded bell for easy cleaning. The size and weight of the ball has been carefully designed to suit the cat's size and strength.

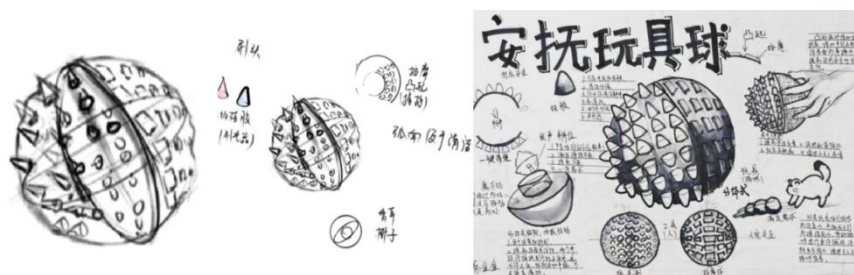


Figure 11: Design sketches

In summary, combining the characteristics of cat nature and human cervical membrane massage ball as the actual starting point of cat soothing massage toy ball, it can be considered in terms of cat's exploration and hunting instinct, scratching behavior, comfort, massage effect, safety, durability and interactivity. Through clever design and modification, the cervical membrane massage ball can be transformed into a favorite soothing massage toy ball for cats, providing them with a pleasant playing experience while promoting their physical and mental health.



Figure 12: Design model

5.2 Technical Realization and Material Selection

The technical realization of the pet cat soothing massage toy ball mainly relies on the silicone mold one-piece forming technology, which enables the sealing of complex structures and reduces the number of parts to be assembled, thus lowering the assembly cost. In addition, the design of the mold directly affects both the product quality and production efficiency. Theoretically, a hollow structured pet cat toy ball using silicone as a polymer material has good plasticity, water resistance, temperature resistance, chemical corrosion resistance, and other characteristics. Because of these characteristics, silica gel can be molded using mold forming and other processes to produce products with complex internal structure, including hollow structure. The empty structure of silica gel can be further use to improve the adsorption performance, air permeability and shock absorption performance of the products. In terms of material selection, silica gel is preferred because of its safe and environmentally friendly, durable and easy-to-clean characteristics. Meanwhile, intelligent functions can also be integrated as needed to enhance the entertainment and health value of toys.



Figure13: Product Structure Function Display

5.3 Design Optimization and Iteration

The design optimization aspect provides toy balls of different shapes and sizes to suit pet cats of different sizes and preferences. There are different materials for toy balls, such as plastic, plush, etc., to provide different touch and texture. Design interchangeable themes and patterns, such as animals, plants, geometric shapes, etc., to add variety and fun to the product. Provide removable and replaceable stickers or decorations so that users can customize the products according to their own preferences and their pets' preferences.

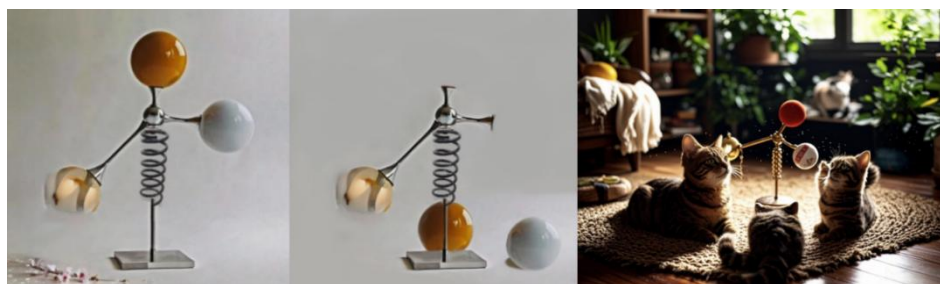


Figure 14: Design Concept Diagram

Product iterations can be launched featuring a compatible magnetic frame for an adsorbable pet cat soothing toy ball, integrating the fixed function and enriching the playing experience of random drop. This design incorporates a mechanism that enables the toy ball to randomly fall off the magnetic frame, increasing the fun and unpredictability of the game. Consider using springs, magnets, or other mechanical devices to implement the random drop functionality.

6. Conclusion

The pre-market background and research study indicate that the pet cat soothing toy ball has a broad market prospect to meet pet owners' needs and improve the quality of life and happiness of pets. The aim of the design is to provide a safe, interesting and interactive toy with emotional design to meet the behavioral and emotional needs of pet cats. There is a strong link between the design of emotional toys and the calming behavior of cats. By meeting the cat's emotional needs, relieving stress and anxiety, facilitating emotional communication, and fostering positive behaviors, emotive toy design can effectively contribute to the production of calming behaviors in cats. The designed pet cat soothing toy ball addresses the limitations of product design in terms of sensory stimulation for pet cats, and achieves a richer and more meaningful human-pet interaction experience. The design optimization considers the fact that in order to meet the needs of pet cats of different body shapes and preferences, different shapes and sizes of toy balls are provided to offer different tactile sensations and textures. Design of interchangeable themes and patterned items, product iteration, can be introduced matching magnetic frame can be adsorbed pet cat soothing toy ball, integrated with the fixed function and enriched with the playability of random drop. The study concluded that the pet cat soothing toy ball design not only meets pet owners' needs for high-quality pet products, but also strengthens the emotional connection between pet cats and their owners through emotional design, improving the quality of life of pets. The optimization and iteration of the design demonstrates the sustainable potential of the product, foretelling the prospect of a wide range of applications of emotional design bringing a new direction to the pet supplies market.

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