Research on the design of pet dog educational toys from the perspective of user experience

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Abstract: With the rapid growth of the pet economy, dog educational toys play key roles in entertainment, cognitive development, and human-pet interaction. However, existing products often suffer from limited function, poor durability, and lack of user experience focus. Purpose: This study targets millennial large dog owners in Europe and the United States, proposing a systematic design approach based on user experience theory. Methods: Using questionnaires, behavioral observation, big data analysis, and user experience mapping, four key elements were identified: functionality, shape and color, size adaptability, and material durability. A multifunctional, modular design with adjustable difficulty was then proposed. Conclusion: Findings indicate that applying user experience theory can enhance product functionality and emotional value, strengthen market competitiveness, and provide guidance for innovation and user experience optimization in the pet products industry.

Keywords: user experience; pet dog educational toys; multifunctional design; modularity

用户体验视角下的宠物狗益智玩具设计研究

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摘　要：随着宠物经济的快速发展，宠物狗益智玩具在娱乐、智力开发和人宠互动中发挥重要作用，但现有产品普遍存在功能单一、耐用性不足及用户体验缺乏等问题。研究目的：本文以欧美千禧一代大型犬饲养者为研究对象，提出基于用户体验理论的系统化设计方法。研究方法：

通过问卷调查、行为观察、大数据分析和用户体验地图，提炼出功能性、造型与色彩、尺寸适配性和材质耐用性四大要素，并提出多功能模块化的设计方案。研究结论：结果表明，引入用户体验理论能够提升产品功能性与情感价值，增强市场竞争力，为宠物用品行业的产品创新和用户体验优化提供参考。

关键词：用户体验；宠物狗益智玩具；多功能设计；模块化

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1. Introduction

With the rapid development of the global pet economy, the scale of the pet products market continues to expand. According to the report of Packaged Facts (2023), pet consumption in Europe and the United States shows a trend of high-end, personalized and functional development [1] . In this context, pet dog educational toys, as pet products that are both entertaining and educational, are gradually attracting the attention of the market and consumers. However, similar products on the current market have problems such as single function, insufficient durability, poor personalized adaptability, and lack of systematic design methods [2] .

In response to this situation, this article, targeting European and American millennial large dog owners, draws on user experience theory and, through questionnaires, behavioral observations, big data collection and analysis, and user experience mapping, explores design optimization paths for dog educational toys across multiple dimensions, including function, shape, size, and material. This article aims to provide theoretical and methodological support for the pet products industry in product innovation, market positioning, and user experience optimization.

2. Research Methods

2.1. Questionnaire Survey

Questionnaires are a crucial part of user experience. Designers formulate questions tailored to specific research objectives and present them to users, who then respond in turn. As a crucial tool for pre-design user research, questionnaires can help designers gain a comprehensive understanding of user demographics through the collection and analysis of extensive data. This study targeted European and American millennial owners of large dogs, collecting data on their functional needs, appearance preferences, and frequency of use for educational toys. The questionnaires addressed functional needs, color and design preferences, and material and durability perceptions.

The questionnaire results show that Americans account for the largest proportion of respondents, accounting for 41%, followed by Canada, France, the United Kingdom and Germany,

as shown in Table 1.

Table 1. Population ratio

nation	Frequency	percentage	Cumulative percentage
America	41	41.00%	41.00%
Britain	10	10.00%	51.00%
Canada	20	20.00%	71.00%
Germany	11	11.00%	82.00%
France	18	18.00%	100.00%
total	100	100.0%	

Among dog owners, 61% of households raise large dogs, 23% of households raise small dogs, and 16% of households raise medium-sized dogs, as shown in Table 2.

Table 2. Percentage of dog breeds by size

body shape	Frequency	percentage	Cumulative percentage
Small dogs	twenty three	23.00%	23.00%
Medium-sized dogs (medi-um-sized dogs)	16	16.00%	39.00%
Large dogs	61	61.00%	100.00%
total	100	100.0%	

According to statistics, frisbee, food-leaking and maze-type educational toys are more popular, as shown in Table 3.

Table 3. Schematic diagram of pet dog preferences

type	n	Response rate	Prevalence
frisbee	79	27.53%	75.24%
vocalization	30	10.45%	28.57%
food leakage	84	29.27%	80.00%
maze	77	26.83%	73.33%
knot	17	5.92%	16.19%
other	0	0.00%	0.00%
Summary	287	100%	273.33%

According to the results of the questionnaire survey, millennials in Europe and the United States pay more attention to the function and price of pet dog educational toys. People like products with good quality and low price. Through the survey, it was found that they still have great expectations for current pet dog educational toys, such as product functionality,

durability, play methods, etc.

2.2. Behavioral Observation

Observation is a method of collecting basic social data or original data. It obtains data on social phenomena and behaviors related to the research objectives through direct perception and recording [3] . It uses vision as the main means, with auxiliary means such as hearing, touch, intuition, and extended means such as recording, video recording, and filming to obtain information [4] . The content of observation includes some behaviors that contain habitual behaviors that are difficult for humans to detect, and more reliable information can be obtained through observation.

This study filmed three large dogs of different breeds playing together to analyze their behavioral characteristics, including interaction style, bite strength, and patience, and combined the video data with analysis [5] .

The first pet was a large Border Collie, whose interaction with the toy is shown in Figure 1. The Border Collie first used its keen sense of smell to locate the sock and then thought about how to unlock the toy's catch. During this process, it used its nose or front paw to flip the switch, ultimately successfully obtaining the treat. The Border Collie's reaction demonstrated its advanced thinking ability and flexible manipulation, demonstrating its advanced understanding of the toy's structure.

Figure 1. Interaction between Border Collie and toys

The second pet is a large husky. The interactive scene is shown in Figure 2. This husky is a show-class dog with exceptional agility, capable of finding and eating food quickly. Because of its speed and keen reflexes to toys, it is well-suited for unfamiliar and challenging educational toys. The husky's behavior suggests that quickly obtaining food is its primary goal, and the toy's attention should be adjusted based on its reflexes.

Figure 2. Husky and toy interaction

The third pet was a large golden retriever, and the interaction scene is shown in Figure 3. Golden retrievers are among the smartest dogs, quickly and accurately locating treats and expertly exploring the toy structure. The golden retriever's performance demonstrates its primary thinking ability and exploratory spirit, demonstrating precise manipulation and judgment during toy interaction.

Figure 3. Interaction between Golden Retriever and toys

Judging from the interactions of these three pet dogs, they use their own personalized senses, such as smell, hearing, and attention, to conduct multi-dimensional inspections of toys, mainly to enhance their intelligence and problem-solving skills. The dog's behavioral characteristics are related to intelligence and personality, as well as to the cognition of toy structure, providing us with important clues for how to design pet toys that can enhance familiarity and interactivity.

2.3. Big Data User Demand Research

Early search engines, such as Google and

Bing, and crawler tools such as Nutch and Scrapy, developed efficient crawler technologies to create indexes and provide search services on the Internet. Python, due to its ease of learning and rich databases and frameworks, has become one of the preferred programming languages for web crawling [6] . Web crawlers developed using Requests, Scrapy, and Selenium technologies need to be combined with other parsing technologies to extract data and store the target data persistently, as the raw data formats captured are mainly HTML, XML, and JSON [7] . As an automated tool, Python web crawlers simulate the behavior of users browsing web pages, crawl data on web pages, and save them to local files or databases. This technology is widely used in many fields such as search engine optimization, data mining, and public opinion analysis.

Amazon is one of the world's largest e-commerce platforms, with a rich variety of pet toys, including various internationally renowned brands. As of now, there are 18 sites worldwide, supporting 27 languages, and consumers covering 185 countries and regions [8] . This study used crawler technology to collect review data of the top six pet dog educational toys (such as TRIXIE, KONG, Outward Hound, etc.) on Amazon and Chewy platforms, and extracted high-frequency adjectives through natural language processing (NLP) for sentiment analysis. A total of 9,000 user reviews were obtained and analyzed. Data collection used Selenium to automatically access the review page and export it to Excel. Table 4 shows some review samples.

Table 4. User review information extraction

Product ID	time	Comment	address	Star Rating
B0002AR31U	2024.07.27	Put the treat inside of it and your dog will entertain his/her self for hours. I definitely recommend this item.	USA	5
B0002A-R137U	2024.01.24	The only down side was the seller sent us the wrong size, but product is high quality for sure.	USA	4
B087DR8744	2024.03.12	Play Video My little Mango loves it. It didn't take long for him to catch on. The product is very durable and looks like it's easy to wash. Now I don't have to feel guilty leaving my feathered friend home in the cage while I'm working. Would highly recommend.	USA	5
B087DR8744	2023.03.31	My 4 month old Jack Russell puppy was able to solve this in 90 seconds. Otherwise it's a well made puzzle.	Australia	4
B0054Q9T-MA	2024.07.25	Got this for the puppies but it also keeps my toddler entertained playing with them. It was quick and easy to assemble. And has been durable.	USA	5

Leveraging this collected data, we can deeply analyze user preferences for various pet toys, the strengths and weaknesses of each product, and

consumers' actual user experiences and needs. This data-driven collection and analysis approach helps us gain insight into market trends and guide product optimization to better meet market and consumer needs.

This study is based on 9,000 user reviews of pet dog educational toys. It uses preprocessing methods such as data cleaning, word segmentation, and invalid word removal to extract adjectives and perform frequency statistics and word cloud analysis. Data analysis shows that user reviews are generally expressed in concise text form. Compared with long texts, short texts are more immediate, informal, interactive, and sparse in features. These reviews directly reflect users' opinions on the pros and cons of the product and whether the product meets their pet's preferences [9] , providing data support for subsequent sentiment analysis and function optimization. Some important codes are shown in Table 5, and the word cloud diagram is shown in Figure 4.

Table 5. Partial word segmentation processing code

```
import pandas as pd

from wordcloud import WordCloud

import matplotlib.pyplot as plt

from nltk.tokenize import word_tokenize

from nltk import pos_tag

from collections import Counter
```

```
df = pd.read_excel( ' Amazon Reviews.xlsx', engine='openpyxl')

reviews = df['Reviews'].tolist()

text = ' '.join([str(i) for i in reviews])

words = word_tokenize(text)

tagged_words = pos_tag(words)

adjectives = [word.lower().replace("…", "").replace("-", "")
for word, tag in tagged_words if tag in ('JJ', 'JJR', 'JJS') and
len(word.lower().replace("…", "").replace("-", "")) > 1]
```
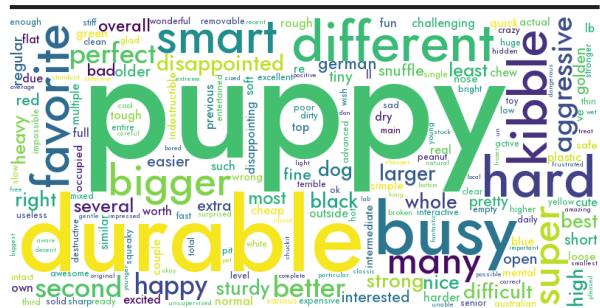

Figure 4. Word cloud of the US site

A word cloud is a visualization tool that shows the frequency of words in text data. In a word cloud, the size of each word is usually proportional to its frequency of occurrence in the text. For example, words such as puppy, durable, busy, kibble, and bigger appear more frequently, which intuitively shows the focus of user comments [10] .

The research results show that users are generally concerned about the durability and size adaptability of toys, as well as their role in intellectual development and emotional interaction.

2.4. User Experience Map

A user experience map is a visual diagram that can be used to show user behavior in a specific area and to discover connections between people, places, and things in service design [11] . This study drew user experience maps for pet

owners and pet dogs, as shown in Figures 5 and 6, analyzing their behavior, needs, and emotional changes at different stages or situations, and identifying potential design opportunities based on pain points.
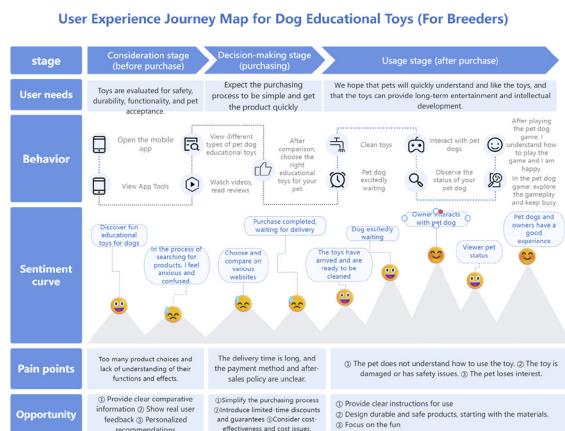

Figure 5. User journey map of pet dog educational toys (owners)
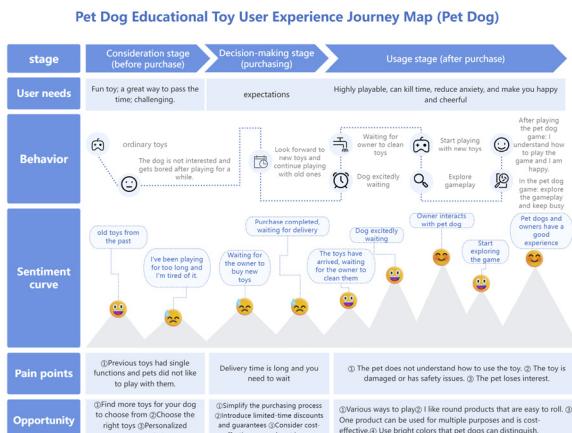
Figure 6. User Journey Map of Pet Dog Educational Toys (Pet Dog)

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Based on a user behavior map analysis of pet owners and pet dogs, five design innovations for pet dog educational toys are proposed:

1.Incorporate multi-sensory stimulation elements (materials, smells, sounds, etc.) to stimulate smell and hearing;

2.Modular free combination structure to adapt to different ages and interests, improving playability and versatility;

3.Environmental adaptability design to meet the needs of multiple scenarios;

4.Use durable and safe materials to extend service life;

5.Set up multi-level challenge mode to maintain pets' continued interest.

3. Results Analysis and Design Practice

3.1. Results Analysis

Through comprehensive questionnaire surveys, behavioral observations, big data analysis, and user experience maps, this study summarizes the four core elements of pet dog educational toy design:

Functional elements

1.The food leakage function prolongs the

eating time through food rewards, prevents health problems and stimulates the desire to explore;

2.Push-pull function: Use the claws to push or pull the toy together, which increases exercise, consumes energy and reduces destructive behavior;

3.The sniffing function guides the dog to search for hidden food by smell, training patience and concentration;

4.The object-seeking function simulates the hunting process, satisfies instincts, relieves anxiety, and enhances interaction with the owner;

5.Interactive function to promote emotional communication and social skills between people and dogs.

These functions not only enhance the fun of the toy, but also achieve the comprehensive effects of physical exercise, intellectual development and emotional interaction in the game, making the toy an important medium for promoting the health and happiness of pets.

Styling elements

In industrial design, a product must not only meet its core functions but also have a certain form of design. In his book Design in Design, Japanese design master Kenya Hara said that "form is the root of attraction" [12] .

The design of pet dog educational toys must balance functional fit with aesthetic appeal. This study focuses on two core elements: cute style and rounded shape. Cute style often uses anthropomorphic or cartoon-like expressions, incorporating animal elements (such as dogs, cats, and rabbits), enhancing relatability and playfulness, aligning with the aesthetic

preferences of European and American millennials and stimulating pets' interest in play. Rounded shape, on the other hand, combines aesthetic appeal with the safety risks associated with sharp features, enhancing comfort and durability. This combination of the two not only satisfies pets' need for interaction but also resonates emotionally with owners.

Dimensional elements

Size design is directly related to the safety and functionality of toys. Considering the differences in bite force among large dogs during infancy, adulthood, and seniorhood, we recommend offering different sizes to accommodate different body sizes and developmental stages, preventing accidental swallowing and ensuring ease of use. The right size not only enhances comfort but also effectively extends the toy's lifespan and overall functionality.

Material elements

Material selection influences a toy's safety, durability, and functionality. Common materials include TPR (thermoplastic rubber), natural rubber, nylon, and PP (polypropylene), which vary in bite force tolerance, flexibility, puncture resistance, and cost. The measured bite force of dogs ranges from 13–1394 N, with an average of approximately 256 N. Therefore, materials with high chew resistance and non-toxic safety are required.

3.2. Design Practice

This design draws inspiration from the shapes and colors of lemons, apples, and avocados, incorporating natural and refreshing visual elements to create a pet dog educational toy that is both aesthetically pleasing and engaging. PP

(polypropylene) is used for safety, durability, and easy cleanability. Complex interactive mechanisms enhance the intellectual challenge. The core gameplay involves rotating and unlocking yellow parts. Pets must rotate the parts to specific positions to receive treats. Compared to traditional leaking or pushing gameplay, this significantly increases the demands for finesse and problem-solving. This design not only extends playtime but also cultivates pets' patience and exploratory abilities. Successfully unlocking the puzzles provides a greater sense of accomplishment and a greater desire for continued participation, as shown in Figure7.
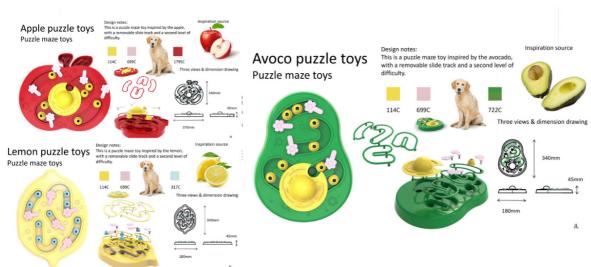

Figure 7. Fruit series puzzle plate model rendering

4. Conclusion and Outlook

4.1. Conclusion

This study, focusing on European and American millennial large dog owners as its core user group, proposed a modular, multifunctional, and adjustable difficulty design for pet educational toys for dogs based on user experience theory. Experimental and user testing results demonstrated that this design excels in functionality, durability, aesthetics, and

cleanability, significantly enhancing the interactive experience between pets and owners and demonstrating strong market competitiveness. Future innovations in pet educational toys should transcend the limitations of appearance and materials, further enhancing functionality and interactivity, and developing personalized and diversified designs tailored to individual dog breeds, thereby leading the way in market development.

4.2. Outlook

In the future design of pet dog educational toys, we will pay more attention to the individual differences of pet dogs and the interactive experience of their owners. The specific contents are as follows:

Incorporate multi-sensory stimulation elements (materials, smells, sounds, etc.) to stimulate smell and hearing; Through in-depth research on pet behavior psychology, we can explore the needs of dogs of different ages, sizes, and personalities, and provide them with more personalized and customized toy options. In addition, with the continuous advancement of intelligent technology, future pet toys are likely to be combined with technologies such as artificial intelligence and the Internet of Things. Through feedback on pet behavior, they can be adjusted accordingly, thereby more accurately meeting the needs of pets.

Environmental protection and sustainable development are the main directions for the design of pet dog educational toys in the future. With the increasing awareness of environmental protection, users have begun to purchase products

made of environmentally friendly materials, recyclable and renewable resources. Therefore, when designing pet dog toys, in addition to considering the pet dog's use experience, more attention should be paid to the selection of materials and the environmental protection of the manufacturing process.

In future toy designs, the social needs of pet dogs will also become an important aspect. As the status of pets in the family has changed, social interaction between them and emotional communication with their owners have become increasingly important. In the future, pet dog educational toys will focus more on the interaction and collaboration between pets, such as through multi-dog interaction and multi-person participation designs to enhance the emotional bond and collaborative ability between pets and their owners.

In short, the design of pet educational toys can promote the physical and mental health of pets, enhance the interaction between pets and owners, and achieve multifunctional innovation in toys, allowing one item to be used in multiple ways. With the development of technology and changes in market demand, future pet dog educational toys will become increasingly intelligent and personalized, becoming indispensable companion tools in the lives of pet owners.

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