

Article

Data Visualization and Visual Design - Creative Applications in Information Presentation and Communication

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Abstract: In an era marked by rapid advancements in information technology and an overflow of data, the marketing strategies for 3C products (computers, communication, and consumer electronic devices) encounter significant challenges. This study emphasizes the critical role of visual elements in Direct Mail (DM) design, especially in the context of communicating complex information about high-tech products to younger consumers. It explores the efficacy of data visualization and creative design in effectively showcasing product features and benefits, thereby attracting the intended consumer demographic. Utilizing methodologies including Pearson correlation analysis, Importance-Performance Analysis (IPA), and Kano regression analysis, the research provides an in-depth understanding of consumer perceptions and expectations related to 3C product DM designs. The findings reveal that aspects such as visualization clarity, narrative allure, design favorability, and the innovative attributes of DM are instrumental in enhancing consumer awareness and satisfaction. The study also identifies established design strengths, like the proficient application of graphic language and comprehensive functional understanding, which contribute to a robust brand image in the consumer psyche. It underscores that in the competitive 3C product market, specific visual design elements are essential in augmenting consumer perception and satisfaction. Brands must actively refine these elements while maintaining and amplifying those design strengths that have already cultivated a solid image among consumers. This approach not only bolsters the brand image but also strengthens market positioning.

Keywords: Direct mail design, Visual elements, Design quality, KANO model

1. Introduction

In an era marked by rapid information technology advancements and information overload, data visualization and visual design play a pivotal role in marketing, particularly for 3C products—computers, communications, and consumer electronics. The challenge lies in effectively communicating these products' complex technical specifications and multifunctionality to consumers. Employing data visualization and innovative visual design is key to highlighting their unique features and benefits, thus capturing consumer interest.

With the younger generation forming the primary demographic for 3C products, marketing strategies, including Direct Mail (DM), need to be innovative and engaging. Traditional methods of product description are less effective for this audience, who favor unique and creatively presented content. Visual design strategies that emphasize product functionalities and advantages can foster a deeper emotional connection and stimulate significant interest among these young consumers.

This study explores how integrating data visualization, creative design, and marketing strategies can help brands excel in the competitive 3C product market, moving beyond traditional methods to achieve significant market success.

2. Literature Review

With the rapid advancement of information technology, modern consumers are daily inundated with an overwhelming volume of data and information. In this context, deploying effective strategies for information transmission and communication is paramount. At the forefront of addressing this challenge are data visualization and visual design.

Data visualization serves to transform complex data into more digestible and understandable formats. Wilkinson (2005) in "The Grammar of Graphics" elaborates that a comprehensive graphical language not only aids in data organization and presentation but also amplifies the effectiveness of message dissemination. Furthermore, Ware (2012) in "Information Visualization: Perception

for Design" explores the role of human visual perception in interpreting information, laying a theoretical groundwork for impactful visualization tools. Yet, effective presentation of information is not solely a matter of visual aesthetics. As Heer and Bostock (2010) argue, a deep dive into how people perceive and cognize information is essential for truly comprehending and assessing diverse visualization designs. This deeper understanding is key to transforming complex data into engaging narratives, a point underlined by Kosara and Mackinlay (2013), who advocate for a storytelling approach in information conveyance to enhance its appeal and persuasive power. Ensuring the efficacy of these visualization tools necessitates empirical research and user feedback. Lam et al. (2012) delve into empirical research scenarios in information visualization, proposing a suite of practical methodologies and recommendations.

In the field of advertising, the strategic use of Direct Mail (DM) increasingly incorporates visual design to engage consumers. Vesanen (2007) posits that the visual design in DM plays a crucial role in capturing consumer attention, rapidly transmitting brand messages, and strengthening brand identity. The study by Peck & Childers (2003) indicates that visual and tactile stimuli are decisive in the consumer decision-making process.

The growing importance of data visualization and visual design is crucial in brand communication, especially for 3C products where technical details and functionalities are key to consumer interest. Clear and sophisticated visual design effectively showcases these aspects, catering to a significant young demographic that values engaging and unique content. Thus, Direct Mail (DM) presentations for 3C products must not only provide clear information but also incorporate creative elements to appeal to this audience. The trend indicates that future marketing strategies for 3C products will increasingly merge data visualization with creative design to effectively engage and influence their young consumer base.

3. Results

This study aims to explore the impact of data visualization and visual design on the efficiency of disseminating 3C product information and their effect on consumer purchase decisions. The methodology unfolds as follows:

Step 1: Development of Consumer-Oriented Direct Mail (DM) Advertisements

Based on theoretical frameworks (Wilkinson, 2005; Ware, 2012; Heer and Bostock, 2010; Kosara and Mackinlay, 2013), nine consumer-oriented DMs were created (Figure 1). These DMs serve as practical examples to demonstrate the application of data visualization and visual design in marketing communication for 3C products, laying the groundwork for subsequent evaluation.



Figure 1. Conceptual Design Diagram of 3C Product DM.

Step 2: Pearson Correlation Analysis and Survey Implementation

Utilizing insights from five experts and relevant literature, the study analyzes factors influencing consumer attraction to 3C products through a comprehensive questionnaire. This step focuses on examining the relationships between visualization clarity, graphical language, narrative appeal, and strategic visual creativity, alongside assessing the impact of creative preferences and core value clarity on product innovation (Table 4).

Step 3: Implementation of IPA Analysis and Expert Interviews

A 15-item questionnaire was developed for an Importance-Performance Analysis (IPA) with a panel of five experts. Analyzing 211 valid responses, the IPA determined the significance and performance satisfaction of various design elements, identifying

effective visual design strategies for 3C products. A Cronbach's Alpha analysis confirmed the survey's high reliability with a score of 0.920.

Step 4: Kano Regression Analysis

This step delves into how different visual design elements, like visual clarity and narrative appeal, influence consumer purchasing decisions and attitudes towards 3C products. The Kano analysis revealed both linear and nonlinear correlations, identifying key design elements that sway consumer behavior.

Overall, these steps form a comprehensive research methodology, from creating DMs to analyzing consumer perceptions, priorities, and behavior through various analytical approaches. This strategy provides a multifaceted assessment of how data visualization and visual design influence consumer decision-making, offering evidence-based insights for enhancing the marketing strategies of 3C products.

4. Research Findings

4.1 Pearson Correlation Analysis

This study examines the role of data visualization and visual design in 3C product marketing, specifically using Pearson Correlation Analysis to understand how design elements like visual clarity, graphical language, and narrative appeal affect information presentation effectiveness. It involves categorizing variables into groups and analyzing correlations using Pearson coefficients to provide empirical support for DM design strategies.

Significant findings from the analysis, as shown in Table 1, reveal strong correlations between visual clarity, graphical language effectiveness, and functional understanding depth. These correlations indicate the importance of clear visual expression and graphical language in enhancing consumer engagement and understanding of 3C products. The research highlights the need for designers to integrate these elements strategically, emphasizing visual clarity and the synergy of design elements for effective market communication and differentiation in the competitive 3C market.

Table 1. Correlation Analysis Between Visual Clarity and Graphical Language.

	1. Clarity of Visualization	2. Effectiveness of Graphical Language	3. Depth of Functional Understanding
1.Clarity of Visualization	1	0.404**(0.000)	0.388**(0.000)
2.Effectiveness of Graphical Language	0.404**(0.000)	1	0.438**(0.000)
3.Depth of Functional Understanding	0.388**(0.000)	0.438**(0.000)	1

Table 2's analysis shows significant correlations between narrative appeal, visual/tactile attractiveness, and design favorability in 3C product design. Notably, narrative appeal strongly correlates with both visual/tactile attractiveness (coefficient of 0.418) and design favorability (coefficient of 0.482), indicating that incorporating narrative elements enhances overall design appeal. This approach is particularly effective in engaging younger consumers, as it translates technical features into relatable stories, intensifying both visual and tactile appeal and impacting initial consumer perceptions and brand favorability.

Table 2. Correlation Analysis Between Narrative Appeal and the Synergistic Effects of Design Techniques

	4.Narrative Appeal	8.Visual/Tactile Attractiveness	10.Design Favorability
4.Narrative Appeal	1	0.418**(0.000)	0.482**(0.000)
8.Visual/Tactile Attractiveness	0.418**(0.000)	1	0.439**(0.000)

The study shows significant correlations between brand communication, core value clarity, and visual creativity, with notable relationships indicated by P-values less than .01. Specifically, brand communication correlates with strategic visual creativity at .428 and with core value clarity at .407, while the latter pairs with visual creativity at .361. This emphasizes the importance of integrating visual creativity in brand identity, enhancing the clarity and distinctiveness of core values. Effective visual strategies can improve brand message comprehension and market appeal. The findings suggest that integrating visual creativity with core brand messaging is crucial for impactful market strategies, requiring collaborative efforts between brand strategists and designers for optimal consumer engagement and competitive positioning.

Table 3. Correlation Between Brand Communication and Strategic Visual Creativity Explored

	6.Brand Communication in Design	12.Clarity of Core Values	14.Visual Creativity in Strategy
6.Brand Communication in Design	1	.407**(.000)	.428**(.000)
12.Clarity of Core Values	.407**(.000)	1	.361**(.000)
14.Visual Creativity in Strategy	.428**(.000)	.361**(.000)	1

Table 4's analysis shows significant positive correlations between consumers' preference for creative design, innovative characteristics of Direct Mail (DM), and visual factors in purchase decisions, with key correlations noted at .532 and .514 respectively. These findings highlight the importance of creativity and innovation in product design and marketing, indicating that innovative DMs enhance product appeal and influence consumer purchasing decisions. In the competitive 3C market, innovative and visually appealing DMs are crucial for differentiating products and shaping consumer preferences, underlining the need for creative and strategic collaboration in marketing and design for effective consumer engagement.

Table 4. Analysis of the Impact of Creative Preferences and Core Value Clarity on Innovative Characteristics

	13.Innovative Characteristics of Direct Mail (DM)	15.Visual Factors in Purchase Decision-Making	13.Innovative Characteristics of Direct Mail (DM)
11.Preference for Creative Design	1	.532**(.000)	.514**(.000)
13.Innovative Characteristics of Direct Mail (DM)	.532**(.000)	1	.392**(.000)
15.Visual Factors in Purchase Decision-Making	.514**(.000)	.392**(.000)	1

4.2 Analysis of IPA Results

The Importance-Performance Analysis (IPA) for the Direct Mail (DM) design of 3C products (Sample 1) reveals that areas requiring active enhancement include the clarity of visualization, narrative appeal, the influence of visual design choices, favorability of the design, and the DM's innovative characteristics. These elements have been identified as critical factors by consumers when evaluating 3C products, and inadequate performance in these areas may directly impact their purchasing decisions. Proactively improving these elements is essential for enhancing the overall product perception and influencing consumer purchasing intent.

Regarding existing strengths, Sample 1 excels in aspects such as the effectiveness of graphical language, the depth of functional understanding, the integration of design with technology, preference for creative design, and visual creativity within strategic approaches. This indicates that these facets are currently meeting or surpassing consumer expectations and should be viewed as strong suits of the brand. Continuing to develop and enhance these strengths is vital for consolidating the brand's position in the market.

For design aspects marked as 'Secondary Improvement,' including brand communication in design and visual factors in purchase decisions, the IPA suggests that these elements, while not primary drivers of consumer satisfaction, still hold potential for enhancement. Brands should evaluate the cost-effectiveness of improving these elements, considering adjustments to brand message delivery or subtle changes to visual elements that enhance brand and product perception without substantially increasing costs.

Furthermore, aspects such as empirical and feedback needs, visual/tactile attractiveness, and clarity of core values in Sample 1 are categorized as 'Resource Waste.' This categorization suggests that current over-investment in these elements is unlikely to proportionally increase consumer satisfaction, and hence, they should not be prioritized for resource allocation. Brands may need to explore cost-effective methods for managing these design elements or develop more efficacious strategies to augment their consumer appeal.

In summary, the IPA results for Sample 1 provide clear directives for current visual design and information presentation approaches. Brands should focus on areas identified for 'Active Improvement' to boost consumer satisfaction and market competitiveness. Simultaneously, maintaining current strengths while strategically addressing elements earmarked for 'Secondary Improvement' and 'Resource Waste' will be crucial for effective resource utilization and enhancing the efficiency of information presentation and transmission in 3C products. Future market strategies and visual design practices should not only aim to enrich the visual experience of consumers but also respond more accurately to their needs.

	Importance (M=4.36)	Satisfaction (M=4.26)	IPA Analysis
1. Clarity of Visualization	4.43	4.11	Active Improvement
2. Effectiveness of Graphical Language	4.48	4.33	Maintain Strength
3. Depth of Functional Understanding	4.40	4.27	Maintain Strength
4. Narrative Appeal	4.40	4.12	Active Improvement
5. Empirical and Feedback Necessity	4.24	4.38	Potential Overkill
6. Brand Communication in Design	4.27	4.21	Minor Improvement
7. Impact of Visual Design Choices	4.50	4.17	Active Improvement
8. Visual/Tactile Attractiveness	4.03	4.34	Potential Overkill
9. Integration of Design and Technology	4.42	4.27	Maintain Strength
10. Design Favorability	4.39	4.15	Active Improvement
11. Preference for Creative Design	4.43	4.35	Maintain Strength
12. Clarity of Core Values	4.30	4.30	Potential Overkill
13. Innovative Characteristics of DM	4.44	4.12	Active Improvement
14. Visual Creativity in Strategy	4.39	4.47	Maintain Strength
15. Visual Factors in Purchase Decision-Making	4.22	4.23	Minor Improvement

4.3 Analysis of Results from Kano Regression

In today's era of information saturation, data visualization and visual design have become integral in communicating information about 3C products. The Kano regression analysis, as detailed in Table 5, classifies elements like clarity of visualization, effectiveness of graphical language, and depth of functional understanding as 'Indifferent.' This classification suggests that while these elements are basic consumer expectations, their enhancement may not directly increase satisfaction; however, poor implementation could lead to dissatisfaction.

Elements such as narrative appeal, empirical and feedback necessity, brand communication in design, innovative characteristics of DM, and visual creativity in strategic approaches are categorized as 'Must-be.' These are essential design aspects that significantly impact consumer satisfaction. This indicates that in 3C product visual design, clear information presentation should be complemented with narrative and innovative elements to engage consumer interest and emotions, thereby influencing purchase decisions.

Visual/tactile attractiveness falls under the 'Attractive' category, highlighting its potential to surprise and elevate consumer satisfaction and brand loyalty. This is particularly relevant in the 3C product market, where consumers seek sensory engagement and novel experiences, positioning such elements as critical for brand differentiation.

The Kano model analysis underscores the need for a balanced approach in 3C product DM visual design, integrating basic expectations with value-adding attributes. 3C brands, in crafting DMs and other marketing communications, should focus on merging information clarity with allure, fostering distinctive consumer experiences through storytelling and visual creativity. Such strategies fulfill basic consumer expectations and augment market appeal by incorporating 'Attractive' elements, securing a lead in the realm of information presentation and transfer.

Additionally, these results offer clear directives for industry stakeholders in 3C product DM design, emphasizing the importance of innovative characteristics and strategic visual creativity. This is not only pivotal in connecting with younger audiences but also in driving purchase decisions. Market strategies for 3C products should blend data visualization and visual design creativity to ensure effective communication and provide an engaging purchase environment. The Kano model's insights reveal the significance of each design element in the process of information conveyance and underscore creativity's pivotal role in attracting consumer favor and influencing purchasing behavior. By leveraging these insights, brands can design visual communication strategies for 3C products that resonate with and exceed consumer expectations.

Table 5. Quality Classification Based on Kano Regression Analysis

Quality attributes	β_1	sig.	β_2	sig.	R2	Quality Classification
1.Clarity of Visualization	.057	.574	.153	.130	.014	Indifferent
2.Effectiveness of Graphical Language	-.150	.158	-.106	.318	.010	Indifferent
3.Depth of Functional Understanding	-.091	.348	.055	.569	.018	Indifferent
4.Narrative Appeal	-.267	.004	-.038	.680	.059	Must-Have
5.Empirical and Feedback Necessity	-.260	.003	.067	.441	.094	Must-Have
6.Brand Communication in Design	-.198	.021	.079	.351	.064	Must-Have
7.Impact of Visual Design Choices	-.092	.344	.162	.097	.057	Indifferent
8.Visual/Tactile Attractiveness	-.087	.297	.165	.049	.052	Attractive
9.Integration of Design and Technology	-.172	.082	.018	.852	.035	Indifferent
10.Design Favorability	.069	.473	.188	.053	.022	Indifferent
11.Preference for Creative Design	.054	.594	.100	.323	.005	Indifferent
12.Clarity of Core Values	-.055	.533	.090	.306	.017	Indifferent
13.Innovative Characteristics of DM	-.279	.004	-.080	.397	.053	Must-Have
14.Visual Creativity in Strategy	-.245	.011	-.605	.493	.042	Must-Have
15.Visual Factors in Purchase Decision-Making	-.356	.000	-.020	.806	.119	Must-Have

5. Conclusion and Recommendations

In the highly competitive domain of 3C products, the visual components of Direct Mail (DM) designs are of paramount importance. This study explores the substantial influence these visual design elements exert on enhancing consumers' cognition and satisfaction levels. Utilizing sophisticated analytical techniques, the research offers an in-depth insight into consumer attitudes and expectations regarding the visual aspects of 3C product DMs.

The findings highlight the critical impact of various visual design elements on captivating and satisfying customers. Central to this is the clarity of visualization, which significantly influences how consumers understand and absorb product information. Moreover, the appeal of storytelling within the design effectively heightens DM attractiveness, consequently garnering more attention to the product. Additionally, aspects such as the favorability of the design and the innovative characteristics of DM contribute substantially to elevating consumer cognition and satisfaction. The study also identifies that the effective use of graphical language and a profound understanding of functionalities have cemented a robust brand image in the consumer psyche. This indicates that while certain areas necessitate further enhancements and innovations, there are existing design elements that merit retention and fortification.

In conclusion, the research underscores that specific key visual design elements in the DM design of 3C products have a noteworthy impact on augmenting consumer cognition and satisfaction. Addressing the modern consumer's expectations necessitates a proactive refinement of these elements while also maintaining and reinforcing those aspects that have already established a steadfast image among consumers. Such strategic focus not only assists in bolstering the brand's image but also positions it more favorably in the intensely competitive marketplace.

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