Research on the Color Image of Online Furniture Showrooms with 2D and 3D Backgrounds

2D および 3D 背景のオンライン家具ショールームのカラー画像に関する調査

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概要:
この調査では、消費者がオンラインで家具を購入するときに表示される製品展示の Web ページのカラー画像に焦点を当てています。オンラインショッピング Web ページの製品画像は、製品とともに 2D 単色背景の 3D 空間でレンダリングされます。知覚されるカラー画像は 2D と 3D の背景で異なります。小林重順さんの作品のカラー画像スケールから 180 色の形容詞を集めました。次に、空間的関連性の低い形容詞を削除し、15 人のデザイン専門家を対象にアンケート調査を実施して適切な形容詞を選択しました。専門家は、室内空間についてのアンケートに含まれていない形容詞を挙げるように促され、33 の形容詞が得られました。最後に、212 人の参加者へのアンケート調査を文献の形容詞と比較して、5 つの代表的な形容詞、すなわち、明るく、モダンで、エレガントで、新鮮で、自然なものが総括されました。
家具のショールームのサンプルには、スペースに配置された一般的なソファが含まれています。 2D および 3D の背景には、白、灰色の 2 つのニュートラル、その他 8 つの色を含む 10 色が使用されました。 2D と 3D の背景色は同じで、合計 20 の実験サンプルがあります。
45 人の参加者に、20 の実験サンプルに対する 5 つのカラー画像の形容詞に基づいたアンケート調査を実施するよう招待しました。同じ色の 2D と 3D のペアサンプルを分析した後、8 つのグループに有意差があり、2 つのグループに有意差がないことがわかりました。 2D と 3D のカラー画像が異なることを検証すると、この調査の結果は、色の推奨事項を提供するオンライン家具ショールームの設計に役立ちます。

Key Word：online showroom, color image, space

1. INTRODUCTION

The COVID-19 pandemic has led to a decrease in people's willingness to go out and shop. Due to the sharp drop in foot traffic, the sales situation of physical stores is grim, especially for furniture stores that require large areas and high operating costs. Online shopping can avoid the infection risk of physical store purchases, and online sales and purchases have become a new trend for human consumption and purchases in the future. This study focuses on color images of product showroom webpages that consumers see when purchasing furniture online. In the past, product images in online shopping web pages used a single color on a 2D background. Today, with the advent of virtual reality, products will be presented in three-dimensional space. Will the perceived color image be different for 2D and 3D backgrounds? This issue deserves further exploration and in-depth study, especially in the context of on-line shopping.

2. LITERATURE REVIEW

The 180 color adjectives [1] in the color image scale of Kobayashi Shigeshun's works are only for 2D color imagery. Whether these adjectives are suitable for 3D color imagery is still an open question. It was reported in the literature that color could affect emotional and physiological responses in reality in VR replicas of the same environment, participants also experienced an increase in positive emotions [2]. In addition, on some Color Image Scale, each color had three properties: warm or cool, soft or hard, clear or light gray, which were related to symbolic hue, value, and chromaticity [3]. Furthermore, color emotions were independent of culture among countries [4], however, they were all just a single color and emotion, not a spatial color image.

3. METHOD

3.1 Adjective Selection

The adjectives for experiments were determined in three stages. First, the author collected 180 color adjectives from the color image scale of Kobayashi Shigejun's work. Second, adjectives with low spatial relevance were removed, and then a questionnaire survey was conducted among 15 design experts to select appropriate adjectives. Among the experts, there were 10 senior interior designers and 5 senior university teachers with design teaching experience. Experts were encouraged to provide appropriate adjectives not included in the interior space questionnaire, resulting in 33 consensus adjectives (Table 1). Finally, through a questionnaire survey of 212 participants and a comparison of adjectives in the literature, five important and representative color image adjectives were identified, namely bright, modern, elegant, clean and fresh, and natural (Table 2).

3.2 Experimental Samples

A sample of the furniture showroom included a set of common sofas placed in the space. Ten colors were used

Table 1 33 Important Color Image Adjectives

33 Important Color Image Adjectives					
clean and fresh	modern	elegant	bright	natural	young
Aristocratic	simple	rustic	tasteful	romantic	peaceful
Japanese	placid	Classic	urban	luxurious	Flamboyant
composed	plain	Chic	graceful	cheerful	Hot
nostalgic	supple	pastoral	Ethnic	tropical	masculine
feminine	Dreamy	cute			

Table 2 5 Important Color Image Adjectives

5 Important Color Image Adjectives				
bright	modern	elegant	clean and fresh	natura

Table 3 2D&3D background

	2D	3D	Lch
Red			L*=70、C*=30、h=0°
orange			L*=70、C*=30、h=45°
Yellow			L*=70、C*=30、h=90°
green			L*=70、C*=30、h=135°
blue-green			L*=70、C*=30、h=180°
Blue			L*=70、C*=30、h=225°
Indigo			L*=70、C*=30、h=270°
purple			L*=70、C*=30、h=315°
Gray			L*=70、C*=0°
White			L*=100、C*=0°

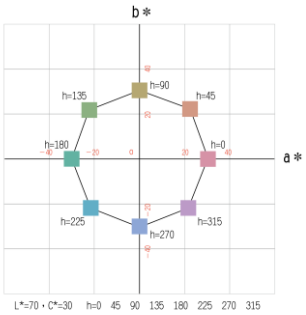

Fig.1. 2D&3D CIE a*-b* for 8 color sample background colors

in the 2D and 3D backgrounds, including 2 neutral colors (white and gray) and 8 other colors with a chromaticity value C* of 30 in the CIELAB color space. The L* values of the other 8 colors were all set to 70, and the hue angle h were spread with 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315° (Fig.1.). In order to achieve consistent 2D and 3D background colors, a 3D space was constructed using 3D modeling software. Adobe Photoshop software was used to adjust the CIELAB color value from the front wall center point in 3D space to the 2D sample. Therefore, there were a total of 20 experimental samples (Table 3). The foreground of these experimental samples were the same white sofa, with the same color and size.

3.3 Experimental conditions

The color was the only variable, and the monitor used in the experiment was calibrated. In the experiment, a large-scale projector was used to display the samples, and the samples were displayed randomly. It was controlled that 2D & 3D of the same color cannot appear before and after, and each sample needed to display a gray card for 10 seconds to avoid being affected by the afterimage of the previous sample.

In the experiment, 45 undergraduate and graduate students were recruited from the Department of Design. Their tasks were to watch 20 experimental samples displayed by a large-scale projector, and evaluated the degree of agreement in five color image adjectives through questionnaires with 7-point Likert scale.

4. RESULTS AND DISCUSSION

Among the response from 45 participants, 42 were valid. These data were used to analyze the paired samples in 2D and 3D of the same color.

Table 4 The Results of Paired Sample Test

Paired sample test				
	adjective	t	degrees of freedom	Significance (two-tailed)
blue-green	bright	4.036	41	.000
	modern	-.966	41	.340
	elegant	-3.140	41	.003
	clean and fresh	-1.997	41	.052
	natural	-2.997	41	.005
green	bright	3.777	41	.001
	modern	.493	41	.625
	elegant	-1.378	41	.176
	clean and fresh	1.311	41	.197
	natural	-.766	41	.448
Red	bright	2.242	41	.030
	modern	-1.657	41	.105
	elegant	-3.287	41	.002
	clean and fresh	-4.357	41	.000
	natural	-3.300	41	.002
purple	bright	1.000	41	.323
	modern	-1.762	41	.086
	elegant	-4.905	41	.000
	clean and fresh	-3.745	41	.001
	natural	-3.540	41	.001
Yellow	bright	1.583	41	.121
	modern	.881	41	.383
	elegant	-.642	41	.524
	clean and fresh	-.178	41	.860
	natural	-1.751	41	.087
orange	bright	2.134	41	.039
	modern	-.682	41	.499
	elegant	-4.292	41	.000
	clean and fresh	-1.861	41	.070
	natural	-4.031	41	.000
Indigo	bright	2.134	41	.039
	modern	-2.279	41	.028
	elegant	-5.272	41	.000
	clean and fresh	-.488	41	.628
	natural	-1.990	41	.053
Blue	bright	3.454	41	.001
	modern	-2.503	41	.016
	elegant	-3.949	41	.000
	clean and fresh	-2.645	41	.012
	natural	-5.009	41	.000
Ash	bright	-.107	41	.915
	modern	-.298	41	.767
	elegant	-2.153	41	.037
	clean and fresh	-.474	41	.638
	natural	-2.596	41	.013
White	bright	-.136	41	.893
	modern	-3.853	41	.000
	elegant	-5.264	41	.000
	clean and fresh	-2.537	41	.015
	natural	-4.015	41	.000

The results of paired t-test revealed that significant differences ($P < 0.05$) were identified in 8 color groups (Table 4). There were no significant differences in Yellow and Gray groups ($P > 0.05$). Color samples with significant differences for 5 adjectives were summarized in Table 5. These results concluded that 2D and 3D color imagery are different.

Table 5 Color samples with significant differences for 5 adjectives

bright	blue-green, green, Blue
modern	White
elegant	blue-green, Red, purple, orange, Indigo, Blue, White
clean and fresh	Red, purple
natural	Red, purple, orange, Blue, White

5. CONCLUSION

The results of this study demonstrate that 2D and 3D color imagery will be different, and the previous 2D color imagery cannot be applied to 3D. This study can provide color suggestions to help designing online furniture showrooms.

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