

# Effect of Elements of Color on the Perceived Price of Online Products

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Received 20 August 2021; received in revised form 11 November 2021; accepted 26 December 2021

## Abstract

In recent years, online shopping has developed rapidly. COVID-19 broke out in 2020, further accelerating this change and increasing the proportion of online shopping significantly. So far, most research related to online shopping has discussed consumer behavior and perceived price through background colors of products, price, and gender. However, few studies are about returns and refunds due to the inconsistency between physical products and online pictures.

The purpose of this study is to explore whether elements of color have a significant impact on perceived price of online 3C products, and whether the results will be affected by gender and different product involvement. Elements of color include brightness, chroma, and hue. The variable hue is excluded by the study based on its clearly visible difference in color. The experiment is divided into five groups: brightness $\pm$ 30, chroma $\pm$ 30, and original.

Research shows elements of color can have an effect on the perceived price of 3C products. And elements of color have a statistically significant impact on perceived price of online 3C products for women but not for men. In addition, there is significant impact on the perceived price of 3C products under different brightness and chroma for high product involvement degree. This study provides online sellers with recommendations for adjusting brightness and chroma for 3C products in order to increase consumers' perceptions of prices. Compared to a baseline of no difference in color, these changes can increase the perceived price of products held by consumers and increase sales of products.

*Keywords: Elements of color, online shopping, perceived price*

## 1. Introduction

In recent years, online shopping has developed rapidly. Moreover, products images often affect consumers' perceived price on the website. However, after receiving the goods, consumers sometimes dispute the color difference between products and images on the website. This study explores whether elements of color have a significant impact on perceived price of online 3C products.

### 1.1 Background and Motivation

As Internet usage increases and expands, the online shopping model is changing and developing rapidly. Many companies hope to increase their online corporate presence while reducing their marketing and product-related costs. Kantar Market Research (2020), a data analytics and brand consulting firm based in London, shows that 54% of all shopping by Taiwanese consumers is online, and 34% of consumers who previously shopped in-person now exclusively shop online. Online shopping not only provides consumers convenience and the ability to compare prices fast, but also offers greater choices. Nonetheless, some unpredictability remains as consumers cannot see or feel online products before making a purchase.

### 1.2 Research Purpose

This study explores whether elements of color have a significant impact on consumers' perceived

price of 3C products while online shopping. The stated goals of this research are as follows:

- (1) Review literature relating to elements of color and their impact on perceived price to support research framework.
- (2) Explore the impact of elements of color on perceived price of online 3C products.
- (3) With the interference of gender and products involvement degree, analyze the impact of elements of color on perceived price of online 3C products.
- (4) Provide reference for future research after compiled research results.
- (5) Apply research results to E-commerce, which could increase consumers' perceived price and prevent consumer disputes.

### 1.3 Research Process

First, we determined the research topic, established the research purpose based on the problem background and research motivation, and then collected literature to support our research framework. After the hypothesis was established, we conducted experiments to verify the hypothesis. We then collected samples for data analysis, in order to verify or overturn the previous hypothesis, form the research results, and write conclusions and recommendations based on the results. Finally, samples were collected for data analysis, and research results, conclusions, and suggestions were provided.

## 2. Literature Review

Product image is the most important factor in a consumer's decision to buy an online product. Brightness and chromaticity will lead to different perceptions in different people. In addition, changes in perceived price and product involvement degree also affects the decision to purchase a product. This literature review is divided into elements of color, online shopping, perceived price, and product involvement degree.

### 2.1 Elements of Color

Li (2010) claims that color brightness can help identify the shape or outline of an object and is also related to texture, space, atmosphere, etc. Chroma refers to the purity or saturation of the "pure color" in the color. McAndrew (1995) suggests that hue is determined by the wavelength of reflected light.

Gorn et al. (2004) demonstrates that adjusting the brightness, chroma, and hue of the screen can make users feel relaxed, thereby increasing the perceived speed at which a webpage loads. This affects users' evaluation of the website and the possibility that they will recommend it to others. In addition, Choi and Suk (2015) show that warm colors are more eye-catching than cool and neutral colors. Vivid colors with high chroma gained the greatest attention, although the variable of brightness is not statistically significant. When chroma and hue was adjusted, the icon was more easily noticeable in the eyes of consumers.

Color is of great importance to humans and their shopping behaviors. It can not only affect emotions, perceived value, and concentration, but also affect consumers' purchasing decisions.

### 2.2 Online Shopping

Hu (2016) shows the two-way communication with consumer and seller on the response time and scenario. Online shopping is the business of obtaining information and making a purchase over the internet. Companies can obtain consumer shopping information and shopping habits and preferences. This in turn improves the interaction with customers and creates a happy shopping experience, which can increase consumers' willingness to use online shopping again. Xi et al. (2020) shows the improvement of e-commerce has promoted the development of B2C online shopping, which has had a significant impact on people's shopping methods and lifestyles.

However, when consumers make online purchases, there are often many uncertainties. In the traditional consumption model, customers can see and touch the product to judge quality. In contrast, online shopping customers must rely on the information provided by the seller, which may not be precise or reliable.

### 2.3 Perceived Price

Because consumers often use price, store name, and brand awareness as product indicators, these issues are widely studied in academia. Septianto and Putra (2020) point out that if the price of a product is maintained for a long period of time, discounts are not necessarily needed to stimulate consumers and increase sales. Consumers will naturally think that this product has a higher perceived price and better quality.

In addition, according to Büyükdağ et al. (2020), perceived price along with purchasing willingness are significantly affected by specific discount patterns in price promotion. When gender was taken into account, perceptions of price by women were impacted while men's were not.

In summary, consumer perception of price is an important factor in making purchases and can affect consumers' willingness to buy a product. Businesses, and particularly those with an online presence, should focus on methods that increase customer perceptions of the price of their goods and services in order to improve sales.

### 2.4 Product Involvement Degree

Lo (2019) defines product involvement as an observable state from which motivation, stimulation, and interest are taken into consideration. It will affect customer selection information and purchasing decisions after which consumers will spend time and energy searching for product information. Tsao (2016) claims that product involvement greatly influences consumer buying behavior in the end. High-involvement consumers make purchasing decisions after collecting information and comparing prices and brands. Low-involvement consumers' purchase procedures are passive. Nonetheless, no matter their degree of product involvement, consumers will be affected by their ideas, environment, product brands, and experience. Therefore, we measure the variable of product involvement by consumer environment and perception of products.

## 3. Methodology

The research framework proposed on the basis of the information in the introduction and literature review. Consumers often dispute the difference between the online product image and the actual product once it is received. This study excludes the variable hue based on its recognizable color difference. The main research variables are brightness and chroma.

### 3.1 Research Framework

This research takes the brightness and chroma of the three attributes of color as the main variables. Interfering variables such as gender and product involvement degree are included in our research to explore their impact on the perceived price of 3C products. Please refer to Figure 3.1.1.

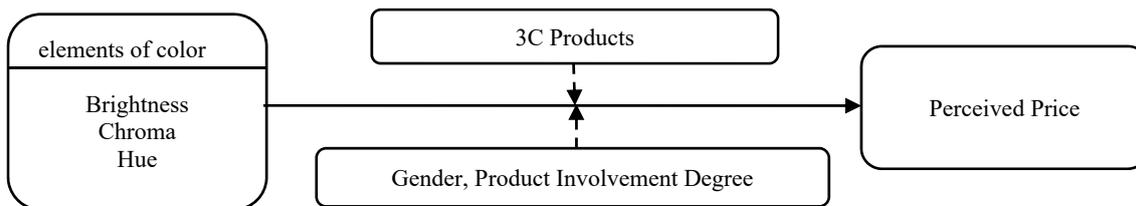


Figure 3.1.1: Research Structure

**3.2 Research Hypothesis**

Based on the research framework, the study proposes three hypotheses:

*Hypothesis 1 (H<sub>1</sub>) : Elements of color have a significant impact on perceived price of online 3C products.*

*Hypothesis 2 (H<sub>2</sub>) : When gender is taken into account, the extent to which color elements exert influence over the perceived price of online 3C products is significant.*

*Hypothesis 3 (H<sub>3</sub>) : When product involvement degree is taken into account, the extent to which color elements exert influence over the perceived price of online 3C products is significant.*

**3.3 Participants**

The experiment is very dependent on the participants' autonomous answers. This study adopts a smaller sample with 30 students in the daytime department of Fu Jen Catholic University to avoid invalid samples from participants who are unwilling to cooperate. Responses were collected over the course of five weeks.

**3.4 Experimental Product**

The control variables of this experiment are 3C products. The researchers selected fifteen images. Ten of the images were chosen from the best-selling online shopping products, and the other five were chosen due to the author's curiosity. They were ranked from high to low based on product involvement data. Rank 1-3 is high involvement of products (phone, notebook, wireless stereo). Rank 7-9 is middle involvement of products (tablet, Bluetooth speaker, game console). Rank 13-15 is

low involvement of products (computer chair, car recorder, video collaboration group).

**3.5 Tools**

We used Photoshop2020 to adjust the brightness and chroma of the experimental pictures, which are adjusted to the original image, brightness ±30, and chroma ±30. After the experiment, SPSS statistics 21 will be used for data analysis.

**3.6 Experimental Procedure**

Participants were asked to complete a product involvement questionnaire, and then respond to a questionnaire that ranks price perceptions on a 5-point scale – 1 being very cheap and 5 being very expensive.

Each experiment is limited to 7 participants. The product name, specifications, and reference price are listed below the experiment picture. Participants were given 20 seconds to respond.

**4. Results**

According to the ANOVA, brightness affects the perceived price of 3C products. The chroma of product images have no significant effect on perceived prices of computer chairs. Finally, the products with significant differences in perceived prices are subjected to the multiple comparison.

**4.1 Elements of Color have a Significant Impact on Perceived Price of Online 3C Products**

Table 4.1.1 Brightness has a significant impact on perceived price of all 3C products. Chroma has a significant impact on perceived price of 3C products, the group includes phone, wireless stereo, Bluetooth speaker, notebook, tablet, game console, car recorder, video collaboration group. Only computer chairs were not significantly affected.

Table 4.1.1: Elements of Color have a Significant Impact on Perceived Price of Online 3C Products.

Item	Product Category	Products	Elements of Color	F	Sig.
Perceived Price	3C Products	Phone	Brightness	7.208	.001***
			Chroma	9.997	.000***
		Wireless Stereo	Brightness	9.139	.000***
			Chroma	9.396	.000***
		Bluetooth Speaker	Brightness	6.701	.002***
			Chroma	3.641	.030**
		Notebook	Brightness	3.480	.035**
			Chroma	4.064	.021**
		Tablet	Brightness	17.471	.000***
			Chroma	7.937	.001***
		Game Console	Brightness	5.395	.006***
			Chroma	2.806	.066*
		Car Recorder	Brightness	3.877	.024**
			Chroma	4.538	.013**

Item	Product Category	Products	Elements of Color	F	Sig.
		Computer Chair	Brightness	2.675	.075*
			Chroma	1.611	.206
		Video Collaboration Group	Brightness	4.708	.011**
			Chroma	8.413	.000***

Annotations: \*\*\*P < 0.01 , \*\*P < 0.05 , \*P < 0.1

Table 4.1.2 The first images used brightness+30 and had low perceived price, including Bluetooth speaker, tablet, car recorder. The second images used original and had low perceived price, including phone, wireless stereo, game console,

video collaboration group. The notebook and car recorder used chroma+30 images and had low perceived price. The results are significant under different brightness with 8 items and under different chroma with 7 items.

Table 4.1.2: The Multiple Comparison on Elements of Color has a Significant Impact on Perceived Price of Online 3C Products

Item	Product Category	Products	Elements of Color	Elements of Color	Mean Difference (I-J)	Std. Error	Sig.		
Perceived Price	3C Products	Phone	Brightness+30	Brightness-30	-.333	.176	.171		
			Original	Brightness+30	-.333	.176	.171		
			Original	Brightness-30	-.667*	.176	.001*		
		Wireless Stereo	Chroma-30	Chroma+30	Chroma+30	-.300	.157	.168	
				Original	Chroma+30	-.7000*	.157	.000*	
				Original	Chroma-30	-.4000*	.157	.044*	
			Wireless Stereo	Brightness+30	Brightness-30	Brightness-30	-.333	.156	.108
					Original	Brightness+30	-.333	.156	.108
					Original	Brightness-30	-.667*	.156	.000*
				Chroma-30	Chroma+30	Chroma+30	-.367	.154	.064
					Original	Chroma+30	-.6667*	.154	.000*
					Original	Chroma-30	-.300	.154	.156
			Bluetooth Speaker	Brightness-30	Brightness+30	Brightness+30	-.600*	.164	.002*
					Original	Original	-.333	.164	.134
					Original	Brightness+30	-.267	.164	.273
		Chroma-30		Chroma+30	Chroma+30	-.267	.151	.216	
				Original	Chroma+30	-.4000*	.151	.034*	
				Original	Chroma-30	-.133	.151	.678	
		Notebook	Brightness+30	Brightness-30	Brightness-30	-.4000*	.152	.035*	
				Brightness+30	Original	-.200	.152	.423	
				Original	Brightness-30	-.200	.152	.423	
			Chroma-30	Original	Original	-.267	.164	.273	
				Chroma+30	Chroma+30	-.4667*	.164	.021*	
				Original	Chroma+30	-.200	.164	.479	
		Tablet	Brightness+30	Brightness-30	Brightness-30	-.467*	.158	.016*	
				Brightness+30	Original	-.933*	.158	.000*	
				Brightness-30	Original	-.467*	.158	.016*	
			Chroma+30	Original	Original	-.4333*	.170	.043*	
				Chroma-30	Original	-.6667*	.170	.001*	
				Chroma-30	Chroma+30	-.233	.170	.393	
		Game Console	Brightness+30	Brightness-30	Brightness-30	-.133	.158	.700	
				Original	Brightness+30	-.367	.158	.073	
				Original	Brightness-30	-.500*	.158	.009*	
		Game Console	Chroma-30	Chroma+30	Chroma+30	-.133	.157	.697	
				Original	Chroma+30	-.367	.157	.070	
				Original	Chroma-30	-.233	.157	.335	
		Car Recorder	Brightness+30	Brightness-30	Brightness-30	-.233	.156	.330	
				Brightness+30	Original	-.433*	.156	.025*	
				Brightness-30	Original	-.200	.156	.442	
			Chroma+30	Original	Original	-.133	.147	.665	
				Chroma-30	Original	-.4333*	.147	.016*	
				Chroma-30	Chroma+30	-.300	.147	.132	
		Computer Chair	Brightness+30	Brightness-30	Brightness-30	-.333	.145	.077	
				Brightness+30	Original	-.200	.145	.391	
				Original	Brightness-30	-.133	.145	.657	
		Video Collaboration Group	Brightness-30	Brightness+30	Brightness+30	-.233	.163	.364	
				Original	Brightness+30	-.500*	.163	.012*	
				Original	Brightness-30	-.267	.163	.268	
Original	Chroma+30			-.7000*	.171	.000*			

Item	Product Category	Products	Elements of Color	Elements of Color	Mean Difference (I-J)	Std. Error	Sig.
			Original	Chroma-30	-.333	.171	.155
			Chroma-30	Chroma+30	-.367	.171	.106

\*. The mean difference is significant at the 0.05 level.

**4.2 When Gender is Taken into Account, the Extent to which Color Elements Exert Influence**

**over the Perceived Price of Online 3C Products is Significant**

Table 4.2.1 Elements of color have a statistically significant impact on perceived price of online 3C products for women but not for men.

Table 4.2.1: When Gender is Taken into Account, the Extent to which Color Elements Exert Influence over the Perceived Price of Online 3C Products is Significant

Item	Product Category	Gender	Elements of Color	F	Sig.
Perceived Price	3C Products	Men	Brightness	.467	.627
			Chroma	1.587	.206
		Women	Brightness	2.393	.092*
			Chroma	3.806	.023**

Annotations : \*\*\*P<0.01 , \*\*P<0.05 , \*P<0.1

Table 4.2.2 The perceived price of 3C products under different chroma is statistically

significant for women. Brightness did not have the same effect.

Table 4.2.2: The Multiple Comparison on Elements of Color has a Significant Impact on Perceived Price of Online 3C Products, when Gender is Taken into Account

Item	Product Category	Gender	Elements of Color	Elements of Color	Mean Difference (I-J)	Std. Error	Sig.
Perceived Price	3C Products	Women	Brightness+30	Brightness-30	-.173	.107	.270
			Original	Brightness+30	-.049	.107	.898
		Women	Original	Brightness-30	-.222	.107	.115
			Chroma-30	Chroma+30	-.235	.108	.097
			Original	Chroma+30	-.278*	.108	.038*
			Original	Chroma-30	-.043	.108	.924

\*. The mean difference is significant at the 0.05 level.

**4.3 When Product Involvement is Taken into Account, the Extent to which Color Elements Exert Influence over the Perceived Price of Online 3C Products is Significant**

products for high product involvement degree. In addition, there is a significant impact on the perceived price of 3C products under different chroma for low product involvement degree.

Table 4.3.1 Elements of color have a significant impact on perceived price of online 3C

Table 4.3.1: When Product Involvement is Taken into Account, the Extent to which Color Elements Exert Influence over the Perceived Price of Online 3C Products is Significant

Item	Product Category	Product Involvement	Elements of Color	F	Sig.
Perceived Price	3C Products	High	Brightness	14.647	.000***
			Chroma	15.903	.000***
		Middle	Brightness	0.349	.706
			Chroma	1.301	.274
		Low	Brightness	0.291	.748
			Chroma	2.376	.095*

Annotations : \*\*\*P<0.01 , \*\*P<0.05 , \*P<0.1

Table 4.3.2 There is significant impact on the perceived price of 3C products under different brightness and chroma for high product involvement degree. There is no statistically significant

impact on the perceived price of 3C products under different chroma for low product involvement degree.

Table 4.3.2: The Multiple Comparison on Elements of Color has a Significant Impact on Perceived Price of Online 3C Products, when Product Involvement is Taken into Account

Item	Product Category	Product Involvement	Elements of Color	Elements of Color	Mean Difference (I-J)	Std. Error	Sig.
Perceived Price	3C Products	High	Brightness+30	Brightness-30	-.3556*	.097	.001*
			Original	Brightness+30	-.1556	.097	.277
			Original	Brightness-30	-.5111*	.097	.000*
		High	Chroma-30	Chroma+30	-.3778*	.096	.001*
			Original	Chroma+30	-.5222*	.096	.000*
			Original	Chroma-30	-.1444	.096	.321
		Low	Chroma-30	Chroma+30	-.2889	.1450	.139
			Chroma-30	Original	-.0333	.1450	.974
			Original	Chroma+30	-.2556	.145	.214

\*. The mean difference is significant at the 0.05 level.

## 5. Conclusions and Suggestions

With every passing year, the proportion of online shopping increases. To avoid consumer disputes arising from perceived differences in color, we used different 3C product photos to explore whether adjusting image brightness and chroma has an impact on consumer perceptions of price in this study.

### 5.1 Conclusions

González et al. (2021) When female consumers purchase products, they will be influenced by discounts, colors, marketing, and comment. On the contrary, men consumers make purchase decision based on products function. The paper is consistent with this study result. The effect on consumer habits is dependent on gender, as female consumers are more sensitive to changes in brightness and chroma of product images while online shopping than are their male counterparts. If the target consumer of the online 3C products is female, images should avoid the use of chroma+30.

In addition, for products with high involvement degree, the participants were affected by brightness and chroma. For products with low involvement degree, the participants were affected by chroma. Consumer perceptions of the price of these products were significantly impacted. The impact of chroma on consumers with low product involvement degree is therefore noteworthy for sellers. Online 3C products should avoid using brightness-30 and chroma+30 when high product involvement degree is present.

There are many factors that affect the perceived price, such as color elements, colors, brands, and discount activities. Our research demonstrates that elements of color do indeed have an impact on the perceived price of online 3C products. This study provides online sellers with a better understanding of the ways that brightness and chroma can be altered for 3C products in order to boost future sales. Not only do these elements appear to increase consumer perceived prices and sales, they may also help to avoid consumer disputes related to color difference.

### 5.2 Suggestions for Future Research

First, the study conducts experiments in the school laboratory because experiments need to use computers and projectors, and would have access to a quiet environment. We suggest inviting participants that are more reflective of a typical online consumer, since all of the participants in the above study were students.

Second, because the participant's perception of the price will be affected by the brand and product's color. We suggest that the study can add brand and product's color variables into research framework. The paper can provide more complete results to online sellers.

Finally, the conclusions drawn from our study provide insight into the ways that elements of color can impact 3C products images for online retailers. We suggest cooperating with online companies to verify that our research results can be widely used in real-time in e-commerce settings.

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