

COLOR STRATEGY IN E-COMMERCE: LEVERAGING REGULATORY FOCUS FOR OPTIMIZED PRODUCT PAGE DESIGN

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ABSTRACT

The advancements in mobile technology have transformed the mobile shopping environment, providing consumers with greater convenience and personalized experiences. However, despite the proliferation of various platforms, product detail pages often follow a standardized design, missing opportunities to enhance consumer engagement. This study aims to investigate the impact of background colors on consumer perceptions and attitudes toward mobile shopping product pages, using Higgins' Regulatory Focus Theory as a theoretical foundation. The results indicate that black backgrounds, symbolizing stability and seriousness, foster positive attitudes among prevention-focused consumers by meeting their preference for reliability and security. In contrast, white backgrounds, associated with brightness, optimism, and vibrancy, are more appealing to promotion-focused consumers, who are driven by growth and achievement. These findings emphasize the psychological influence of background color, demonstrating its potential as a strategic element in e-commerce design. This study provides practical implications for marketers and designers aiming to deliver more tailored consumer experiences in mobile shopping environments.

Keywords: Background color; Regulatory focus theory; Mobile commerce; Product detail pages; Consumer attitudes

1. Introduction

Recent advancements in mobile technology have firmly established mobile commerce as a central retail channel. Within this context, product detail pages (PDPs) play a critical role, significantly influencing consumer evaluations and purchase decisions (Hwang et al., 2021; Patel et al., 2020). Effective PDP design—which includes clear product presentation and intuitive navigation—has been shown to affect customer satisfaction and conversion rates (Harsojo et al., 2022; Sabir, 2020).

Mobile commerce possesses several distinctive features that clearly differentiate it from traditional PC-based e-commerce. First, from a physical perspective, mobile devices have smaller screens, rely heavily on touch-based interactions, and have limited input methods. These constraints fundamentally alter user interface design, influencing how information is presented, visual hierarchies are established, and interactions occur (Lee & Benbasat, 2003). Second, contextually, mobile shopping frequently occurs while users are moving or multitasking—such as commuting—leading to fragmented attention, increased time pressures, and quicker decision-making (Kim, 2021;

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Wolf, 2023). Finally, behaviorally, mobile users typically engage in shorter sessions, visit fewer pages, and exhibit higher impulse-purchase tendencies compared to desktop users (Liu et al., 2020). These unique characteristics emphasize the necessity of design principles specifically tailored to mobile environments and underscore the need to better understand how visual elements—such as background color—shape consumer perception and decision-making (Alzahrani et al., 2018; Johnson & Seeling, 2014; Luo & Zhou, 2015).

To meet usability standards and consumer expectations, many retailers adhere to standardized style guidelines for PDP layouts, resulting in highly similar designs across different platforms (Rodríguez-Torrico et al., 2020). Recent industry analyses have raised concerns about this growing uniformity, suggesting that such design convergence may hinder brand differentiation and reduce the opportunity for more distinctive and engaging consumer experiences (Roederkerk & Lehmann, 2021; Sulikowski et al., 2022).

A promising strategy to address this homogeneity involves strategically leveraging background color—a powerful but frequently overlooked visual component. Extensive research indicates that color significantly influences user experiences by shaping perceptions, emotions, and behaviors within marketing contexts. Recent studies have demonstrated that bright, saturated colors can increase consumer arousal and foster initial trust in online retail environments (Bahrainizad, 2024). Conversely, poorly executed dark-mode interfaces have been associated with decreased perceived attractiveness and readability, negatively impacting user experience (Ma et al., 2023). These findings imply that background colors serve crucial emotional and perceptual roles beyond mere aesthetics (Wilms & Oberfeld, 2018).

To provide theoretical grounding for examining background color's impact, this study draws upon Regulatory Focus Theory (RFT). RFT distinguishes two motivational orientations: a promotion focus emphasizing aspirations, growth, and positive outcomes, and a prevention focus emphasizing security, responsibility, and the avoidance of negative outcomes (Higgins, 2012). According to RFT, alignment—or regulatory fit—between environmental cues and an individual's motivational orientation enhances engagement and promotes positive evaluations (Higgins, 2012). Color psychology research supports this theoretical linkage. For instance, red tones can trigger caution and vigilance consistent with a prevention focus, whereas blue tones often stimulate exploratory and approach-oriented behaviors aligned with a promotion focus (Labrecque & Milne, 2012; Lahmidi & Aomari, 2018). Thus, specific background colors can serve as motivational cues that align with individuals' regulatory orientation. When this alignment occurs, regulatory fit is established, which in turn enhances engagement and leads to more favorable evaluations.

Despite the substantial exploration of color psychology within general e-commerce contexts, the specific intersection between background color and regulatory focus within mobile shopping environments remains underexamined. Recent research indicates that subtle color variations on product pages can significantly alter consumer perceptions and product desirability (Bahrainizad, 2024). However, few studies have explicitly investigated how these effects differ according to consumers' regulatory orientations. Addressing this gap is imperative, as aligning visual design elements with consumers' motivational traits may substantially optimize mobile shopping experiences.

The objective of this research is to explore how background color influences consumer perceptions and attitudes toward mobile product detail pages through the lens of Regulatory Focus Theory. Specifically, it investigates the differential effects of background color (white versus black) on consumers characterized by promotion or prevention orientations. This study synthesizes contemporary empirical findings on color usage within digital contexts with RFT, offering insights that aim to enhance the effectiveness of mobile PDP design and ultimately improve consumer engagement and conversion rates.

2. Literature Review and Hypothesis Development

2.1. Product Pages in Mobile Commerce

The design of product detail pages plays a critical role in shaping consumer behavior in mobile commerce. Compared to traditional PC-based platforms, mobile commerce interfaces face distinctive physical and cognitive constraints, including smaller screen sizes, touch-based interactions, and on-the-go usage patterns (Kim, 2021; Lee & Benbasat, 2003; Liu et al., 2020; Wolf, 2023). These characteristics mean that mobile shopping typically occurs on smaller screens, often while users are multitasking or in transit, necessitating designs that are concise, clear, and visually structured.

As demonstrated by numerous studies, strategic design of product detail pages in mobile commerce plays a crucial role in influencing consumer decisions. For instance, Zhang et al. (2023) emphasize that the accessibility of product pages through diverse search pathways can shape online shopping behavior by guiding how consumers engage with product information. Similarly, Rowley (2000) highlights the importance of structuring and presenting information effectively to support consumer decision-making in digital contexts. Additionally, Wang et al. (2023) underscore the crucial role of product detail pages in reducing choice fatigue by providing clear and concise product information that facilitates easier decision-making. This aspect is particularly vital in mobile commerce where screen real estate is

limited and user attention is highly fragmented. Harsojo et al. (2022) found that visually appealing product images, detailed descriptions, and intuitively navigable reviews significantly influence consumer decision-making in online clothing stores. These findings clearly demonstrate how mobile product detail pages can fundamentally alter how consumers interact with product information and make purchase decisions compared to PC-based platforms (Johnson & Seeling, 2014; Luo & Zhou, 2015).

While prior research has focused primarily on content organization and merchandising quality (Chung & Park, 2013; Szymanski & Hise, 2000), less attention has been paid to how visual design elements such as background color influence engagement on PDPs. Most retailers adopt standardized layouts governed by platform-specific style guides to ensure usability and consistency, which can lead to homogeneity in design and diminished brand identity (Rodríguez-Torrico et al., 2020). This visual uniformity further reduces opportunities for differentiation, especially in mobile contexts where users are less likely to deeply engage with complex pages (Sohn et al., 2017).

Given the limited visual real estate on mobile screens and growing similarity in PDP structures, subtle visual cues such as background color can have outsized effects on user experience. Visual hierarchy, information density, and background tone all influence a user's ease of processing and overall attitude formation toward the page (Xiao et al., 2020; Xiao & Wang, 2023). Yoganathan et al. (2019) has demonstrated that visual sensory cues in digital interfaces can significantly enhance consumer engagement and purchase intentions by creating more immersive shopping experiences. Their analysis of multisensory marketing in e-commerce environments highlighted how visual elements affect both cognitive and affective responses to products. Similarly, Lee et al. (2018) found that platform design strategies substantially influence consumer search behaviors and purchasing patterns, emphasizing how interface elements can shape the effectiveness of online retail environments and drive consumer engagement across different platforms. However, relatively few empirical studies have systematically examined how these fundamental visual elements affect consumer cognition and decision-making in mobile shopping environments. This study aims to address this research gap by conducting an empirical analysis of background color as a subtle yet strategic component in mobile interface design. Specifically, we explore how background color may interact with consumers' regulatory focus—their motivational orientation toward either advancement or security—to shape product attitudes in mobile shopping contexts.

2.2. Background Color and Consumer Perception

Color is a foundational element of visual marketing, influencing consumers' emotions, attitudes, and behaviors. Warm colors (e.g., red, orange) are often associated with excitement and urgency, while cool colors (e.g., blue, green) convey calmness and trust (Labrecque & Milne, 2012; Lahmidi & Aomari, 2018). Beyond hue, brightness and saturation—key perceptual properties—affect cognitive arousal and emotional tone. Bright backgrounds can elevate perceived energy and positivity, which are beneficial in contexts like mobile commerce that rely on immediate user attention (Bahrainizad, 2024; Dai, 2023). In a similar vein, Lee and Rao (2010) demonstrated that a shift in an e-store's ambient color from green to blue significantly elevated consumers' trust, which in turn increased the likelihood of store selection.

Among these attributes, brightness plays a particularly important role in shaping perceptions. White backgrounds, for instance, enhance the perception of brightness, making content appear vivid and lively. White is often associated with purity, cleanliness, and simplicity (Hemphill, 1996). Singh and Srivastava (2011) found that achromatic tones such as white create a cheerful and inviting atmosphere, which positively affects consumer attitudes and behaviors. Similarly, Labrecque and Milne (2012) demonstrated that white backgrounds are perceived as more attractive and approachable, contributing to a positive consumer experience. Saito (1996) supported these findings by suggesting that white evokes a sense of openness and positivity, reinforcing the perception of brightness in digital spaces. These qualities are thought to enhance perceived clarity and friendliness, potentially contributing to a sense of spaciousness and emotional positivity. In mobile contexts, such perceptions may be associated with improved content engagement and reduced cognitive load. Shih and Lin (2024) suggest that bright colors, such as white, tend to generate positive affective contagion effects, enhancing not only brightness perception but also emotional tone. This aligns with the hypothesis that white backgrounds increase perceived brightness and positivity, reinforcing favorable interpretations of content presented against such backgrounds.

In contrast, darker backgrounds like black are associated with seriousness, luxury, and depth (Hagtvedt & Brasel, 2017). These associations evoke a sense of formality and professionalism, often used in premium branding. Research suggests that dark tones can increase cognitive focus and encourage deeper engagement with content (Lahmidi & Aomari, 2018). In mobile environments where distraction is common, black backgrounds may help isolate key information and enhance the perceived earnestness of the content. Psychologically, black is commonly linked to gravity and solemnity (Hemphill, 1996; Na & Suk, 2014). According to psychological distance theory, black backgrounds can induce a sense of distance that enhances perceptions of product exclusivity and desirability. This effect may be particularly effective for marketing strategies aiming to convey a premium brand image (Y. Wang et

al., 2022). In addition, the presence of black in contextual backgrounds has been found to enhance mental imagery and product evaluation. Jeong and Yeu (2023) suggest that black-colored elements can stimulate more vivid mental simulations and improve the perceived usefulness of product reviews, thereby influencing consumer judgments and decisions. However, dark tones such as black are also associated with negative affective contagion, potentially evoking somberness or emotional restraint (Shih & Lin, 2024). While this may seem disadvantageous in some design contexts, in others—such as product presentations requiring trust, precision, or contemplation—this affective tone may positively reinforce the earnestness of the content. Together, these findings suggest that black, as a background color, can meaningfully shape users' perceptions by supporting emotional gravity and cognitive engagement, making it a suitable design choice in contexts that demand perceived seriousness or credibility.

Color is commonly conceptualized across three core perceptual dimensions: hue (color type), saturation (intensity), and brightness (lightness or darkness) (Labrecque & Milne, 2012; Wilms & Oberfeld, 2018). Although prior literature often highlights the emotional associations of hue, the current study emphasizes brightness as the unifying perceptual basis underlying both hypotheses. Specifically, white is positioned at the high-brightness end of the spectrum and is associated with clarity, cheerfulness, and positivity. Conversely, black, while seemingly associated with hue, functions here as a low-brightness cue, linked to solemnity, depth, and emotional seriousness (Jeong & Yeu, 2023; Hagtvædt & Brasel, 2017). Thus, both H1 and H2 are grounded in variations along the brightness dimension, reflecting contrasting emotional impressions elicited by background color.

Building on this discussion, the following two hypotheses are proposed to examine how background color influences consumers' perception of content tone in mobile commerce environments:

H1: When the background color of the product detail area in a mobile environment is presented as white, consumers will perceive the atmosphere of the content as brighter than when it is presented as black.

H2: When the background color of the product detail area in a mobile environment is presented as black, consumers will perceive the atmosphere of the content as more earnest than when it is presented as white.

2.3. Background Color and Regulatory Focus Theory

According to the principles of Regulatory Focus Theory (Higgins, 1997, 2002), individuals pursue goals through two distinct motivational orientations. A promotion focus emphasizes aspirations, advancement, and the pursuit of positive outcomes, whereas a prevention focus prioritizes safety, responsibility, and the avoidance of negative consequences. These orientations have been demonstrated to influence not only the content of goals but also cognitive strategies, decision-making patterns, and responses to environmental stimuli (Aaker & Lee, 2001; Avnet & Higgins, 2006). The theory's central mechanism, regulatory fit, occurs when external cues align with an individual's motivational orientation (Higgins, 2000). This alignment fosters a subjective sense of "feeling right," thereby enhancing engagement and evaluation. Evidence from virtual brand communities supports this mechanism: Wang and Li (2017) demonstrated that promotion-focused members derive greater hedonic and utilitarian value when community cues align with ideal-self framing, underscoring the persuasive power of regulatory fit in digital environments. Within this framework, background color can function as a subtle yet effective environmental cue that evokes emotional tones congruent with consumers' regulatory orientations. See Table 1 for a summary of regulatory-focus characteristics across key studies.

For individuals with a strong focus on prevention, visual elements that convey seriousness and stability have been shown to promote regulatory fit. A substantial body of research has demonstrated that the color black is consistently associated with formality, credibility, and depth (Hemphill, 1996; Jeong & Yeu, 2023). These associations are consistent with prevention-oriented tendencies toward systematic and risk-averse information processing (Chernev, 2004; Pham & Avnet, 2004). The present study's findings are consistent with prior empirical evidence supporting this alignment. Mehta and Zhu (2009) found that darker visual environments enhance analytical accuracy, while Mosteller et al. (2014) reported increased attention to security-related content in dark-mode interfaces. These findings suggest that black backgrounds induce perceptions of earnestness, which align with prevention-focused consumers' motivational orientation.

Conversely, individuals with a promotion focus exhibit heightened responsiveness to positive emotional cues. They also respond more strongly to novel stimuli (Pham & Avnet, 2004). The use of white as a background color has been demonstrated to convey clarity, openness, and optimism. These traits have been shown to be linked to promotion-focused goals such as growth and creativity (Saito, 1996; Singh & Srivastava, 2011). Mehta and Zhu (2009) demonstrated that brighter environments enhance exploratory thinking, and Deng and Poole (2010) found that light-toned interfaces foster perceptions of innovation. Collectively, these findings suggest that white backgrounds promote perceptions of brightness, thereby reinforcing the approach-oriented tendencies of promotion-focused consumers.

It is noteworthy that, within this theoretical framework, the concepts of earnestness and brightness serve as reflections of affective impressions rather than physical luminance. The background color functions as a perceptual-

emotional cue, thereby activating regulatory fit by conveying emotionally significant tones. When these perceptual tones—earnestness or brightness—are aligned with a consumer's regulatory orientation—prevention or promotion—they are expected to enhance product evaluations through motivational congruence.

On the basis of this theoretical integration and corroborating empirical findings, we posit the following hypotheses:

H3: Prevention-focused consumers will exhibit more favorable product attitudes when influenced by earnestness (via a black background) than by brightness (via a white background).

H4: Promotion-focused consumers will exhibit more favorable product attitudes when influenced by brightness (via a white background) than earnestness (via a black background).

Table 1. Summary of Regulatory Focus Characteristics Across Key Studies

Researcher	Content	Keywords by Focus Type	
Zhu and Meyers-Levy (2007)	• People with a promotion focus pursue progress, achievement, and pleasure and take proactive and challenging attitudes to achieve specific goals. • People with a prevention focus seek safety to escape risks.	Pro	Progress, Achievement, Pleasure, Challenge
		Pre	Safety, Risk Avoidance
Avnet and Higgins (2006)	• People with a promotion focus place more importance on their 'feelings' about a product. • People with a prevention focus place more importance on the 'reasons' for a product.	Pro	Feelings
		Pre	Reasons
Crowe and Higgins (1997)	• People with a promotion focus perceive attributes related to desires and hopes positively and tend to make risk-taking decisions. • People with a prevention focus make decisions aimed at avoiding risks associated with responsibility and safety.	Pro	Hope, Positive, Risk-taking
		Pre	Responsibility, Safety, Negative, Risk Avoidance
Friedman and Förster (2001)	• People with a promotion focus are proactive and dynamic when faced with problems, which enhances creative thinking. • People with a prevention focus strive to avoid risks, which diminishes creative thinking.	Pro	Proactive, Dynamic, Creative Thinking
		Pre	Risk Avoidance, Reduced Creative Thinking

Note. Pro: Promotion Focus, Pre: Prevention Focus.

3. Research Method

3.1. Research Design and Data Collection

To ensure data quality and representativeness, the study employed a professional panel provided by Hankook Research, one of South Korea's leading market research firms. Participants were recruited through stratified sampling across gender and age, and all respondents were members of a validated panel. The agency routinely audits and quality-controls this participant pool. The data collection was conducted online over a two-week period via Hankook Research's proprietary web-based survey platform. All participants received a standardized monetary incentive provided by the agency as part of its routine panel compensation policy.

To test the hypotheses of this study, the experimental design involved two primary components. The first was a manipulated construct: the background color of the product pages, which was set at two levels—white and black. The second was participants' regulatory focus orientation, which was not experimentally assigned but post hoc classified based on their responses to a validated regulatory focus scale. Specifically, an index score was calculated by subtracting the mean of prevention focus items from that of promotion focus items. Participants with a positive index were categorized as promotion-focused, and those with a negative index as prevention-focused. To improve the clarity and internal validity of subgroup comparisons, participants whose index scores were close to zero—indicating no clear motivational orientation—were excluded from the analysis. As a result, 226 participants (102 promotion-focused and 124 prevention-focused) were included in the subgroup analysis, while 104 participants were excluded. This classification was used for subgroup analysis in hypothesis testing.

Prior to the main survey, participants were presented with stimuli designed to manipulate the background color factor. These stimuli were modeled after the mobile product detail pages of Coupang, one of South Korea's leading online shopping platforms, to closely replicate a real-world online shopping experience and enhance ecological

validity. The upper section of the product detail pages which included the main product image, pricing, and promotional information, was kept consistent across all versions to ensure uniformity. This design reflected the critical information typically emphasized by consumers in online shopping environments, providing a consistent basis for comparison between different pages. The detailed product information section was developed by referencing actual products available in the market, thus offering participants a realistic context for product evaluation. Two distinct versions of the product detail pages were created. The first version featured a white background beneath the product image (White Color), conveying a clean and bright aesthetic. The second version utilized a black background (Black Color), designed to evoke a sense of luxury and visual contrast. These two background color variations were crucial in examining how such visual elements influence consumer attitudes, particularly regarding product appeal and perceived trustworthiness. Figure 1 visually compares the two background color conditions—white and black—used in the experimental stimuli.



Figure 1. Stimuli for Background Color

A total of 334 participants with prior online shopping experience were recruited for this study. This prerequisite ensured that all participants had familiarity with navigating online shopping platforms, which in turn enhanced the reliability of their responses to the stimuli presented. After removing five responses due to inconsistencies or errors, the final dataset included 330 valid responses. Data collection was conducted entirely online over a two-week period, using a combination of convenience and purposive sampling methods to secure a varied participant pool. The final sample exhibited a balanced gender ratio, consisting of 165 males and 165 females (50% each). The average age of the participants was 34.7 years ($SD = 8.60$), which provided a mix of perspectives primarily centered in the mid-adult age range. Furthermore, 86.2% of participants reported regularly engaging in online shopping using either computers or smartphones, and 87.1% indicated a high level of confidence and comfort with these technologies.

This demographic profile highlights the study's emphasis on a tech-savvy, middle-aged consumer base, ensuring that the findings are generalizable to this significant segment of online shoppers. By recruiting participants with substantial experience in digital shopping environments, the study was able to provide credible insights into how factors such as background color and regulatory focus impact consumer attitudes. Overall, the alignment of the experimental design with real-world consumer behaviors and preferences lends strength to the validity and practical implications of the findings within the context of mobile shopping.

3.2. Measurements

The constructs in this study were assessed using validated survey items adapted from prior research to measure perceived brightness, perceived earnestness, regulatory focus tendencies, and product attitudes. All items were measured using a 7-point Likert scale, ranging from 1 (Strongly disagree) to 7 (Strongly agree), to ensure consistency and reliability in responses.

Perceived brightness of the white background color was measured using items adapted from Baek et al. (2011), who utilized adjective-based emotional response scales to assess reactions to different light colors. These items reflected the positive visual and emotional associations of brightness and included descriptors such as "bright," "clean," and "cheerful." Respondents were asked to rate the extent to which they agreed with statements such as "The product detail page feels bright," "The background color of the detail page feels clean," and "The product detail page feels cheerful." Recent studies have continued to demonstrate that white is consistently associated with positive affective states such as cleanliness, clarity, and cheerfulness (Celhay & Luffarelli, 2024; Dong et al., 2024; Jonauskaitė & Mohr, 2025), supporting the validity of these items in capturing user perceptions of brightness-related emotional tone.

Perceived seriousness of the black background color was also measured using items adapted from Baek et al. (2011), emphasizing emotional attributes such as "earnestness," "solidity," and "stability." Respondents rated their agreement with statements such as "The product detail page feels earnest," "The background color of the product detail page conveys a solid feel," and "The product detail page feels stable." Recent research consistently shows that darker backgrounds, including black, are associated with perceptions of seriousness, formality, and stability (Hagtvedt & Brasel, 2017; Jeong & Yeu, 2023; Shih & Lin, 2024; Y. Wang et al., 2022), thereby validating the use of these items to capture perceptions related to earnestness and stability.

Participants' regulatory focus tendencies were measured using six items adapted from the Regulatory Focus Questionnaire (RFQ) developed by Lockwood et al. (2002), which is widely used to distinguish between promotion and prevention orientations. Promotion focus was assessed with items reflecting a preference for novelty and dynamic experiences (e.g., "I enjoy activities that are continuously changing," "I seek novelty and change in my daily life," "I frequently visit new places such as restaurants or shops"). Prevention focus was measured using items that emphasized risk aversion and a preference for familiarity (e.g., "I prefer comfortable and familiar people and places," "I do not like to engage in risky activities just for pleasure," "I feel best when things are comfortable and safe").

This measurement approach has been consistently adopted in recent regulatory focus studies, demonstrating its continued relevance and validity. For instance, Guo et al. (2024) and Jing et al. (2024) applied the same RFQ framework to assess regulatory tendencies in organizational and healthcare contexts, respectively. To capture each participant's dominant motivational orientation, we computed a composite regulatory focus score by subtracting the average of the prevention-focused items from the average of the promotion-focused items. This scoring method has been widely used in regulatory focus research by Pham et al. (2023) and reflects current practice in studies of motivational predominance.

Finally, attitudes toward the product were measured using three items adapted from Seo and Park (2021). These items captured respondents' overall perceptions of the product's desirability and quality, with statements such as "I like this product," "I believe the quality of this product will be satisfactory," and "I would recommend this product to a friend or family member."

To evaluate the adequacy of the sample size, a post hoc power analysis was conducted using G*Power 3.1. Assuming a medium effect size ($f = .25$), an alpha level of .05, and two groups, the analysis showed that the sample

of 334 participants achieved a statistical power of .995. This indicates that the sample size was more than sufficient to detect the hypothesized effects with high confidence.

4. Research Result

All statistical analyses—including confirmatory factor analysis (CFA), reliability testing, ANOVA, and regression—were conducted using Python (for CFA) and IBM SPSS Statistics (Version 25) for the remaining analyses. The results are presented below in the order of the hypotheses.

4.1. Validity and Reliability

In line with prior research that utilized validated existing scales (Shan et al., 2021; X. Wang et al., 2022), this study employed Confirmatory Factor Analysis (CFA) to evaluate the construct validity and internal consistency of the measurement model. CFA was particularly appropriate given that all measurement items were adapted from previously established scales. The analysis was conducted in Python using the pandas, NumPy, and factor analyzer packages, with an emphasis on item-level diagnostics.

Prior to CFA, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity were conducted to assess the suitability of the data for factor analysis. The KMO value was .854, indicating meritorious sampling adequacy, and Bartlett's test was significant ($\chi^2 = 3487.572$, $df = 105$, $p < .001$), confirming that the correlation matrix was factorable.

CFA was then performed on five latent constructs: Attitude, Perceived Brightness, Perceived Earnestness, Promotion Focus, and Prevention Focus. Each construct was measured using three theoretically grounded items. All standardized factor loadings exceeded the recommended threshold of .600, ranging from .670 to .875, which satisfies the criterion for convergent validity (Brown, 2015). Additionally, Cronbach's alpha coefficients for all constructs ranged from .840 to .936, surpassing the commonly accepted threshold of .700 for acceptable internal consistency (Nunnally & Bernstein, 1994).

These results collectively support the convergent validity and internal consistency of the measurement model. A summary of the CFA results, including item-level standardized loadings and Cronbach's alpha values for all five constructs, is presented in Table 2.

Table 2. Factor Loadings and Reliability

Construct	Indicators	Standardized Loading	Cronbach's α
Attitude	Att1	.875	.936
	Att2	.865	
	Att3	.796	
Perceived Brightness	Bri1	.760	.840
	Bri2	.720	
	Bri3	.800	
Perceived Earnestness	Ear1	.770	.850
	Ear2	.740	
	Ear3	.810	
Promotion Focus	Pro1	.670	.840
	Pro2	.710	
	Pro3	.780	
Prevention Focus	Pre1	.730	.850
	Pre2	.750	
	Pre3	.790	

Note. All loadings are standardized estimates. Cronbach's alpha coefficients indicate strong internal consistency. Factor loadings exceeding .600 confirm convergent validity (Brown, 2015; Nunnally & Bernstein, 1994).

4.2. Hypothesis Testing

Before testing the hypotheses, a manipulation check was performed to ensure the effective manipulation of the independent variables. Respondents were exposed to stimuli on product detail pages featuring different background colors and assessed using two Semantic Differential Scale questions: (1) "Is the background color of the product detail pages a black tone or a white tone?" and (2) "Does the background appear dark versus bright?" A significant mean difference between the dark background condition ($M_{\text{dark}} = 3.415$, $SD = 1.444$) and the bright background condition ($M_{\text{bright}} = 5.271$, $SD = 1.067$) was observed, $F(1, 328) = 176.754$, $p < .001$, confirming that the background color manipulation was successful. Figure 2 shows the mean differences in perceived earnestness and brightness between the two background color conditions.

To validate Hypotheses 1 and 2, a one-way ANOVA was conducted to examine the impact of background color on participants' perceptions of tone and mood. The results demonstrated that the content was perceived as more earnest when displayed against a black background ($M_{\text{black}} = 4.610$, $SD = 1.287$) compared to a white background ($M_{\text{white}} = 4.329$, $SD = 1.082$), yielding a statistically significant difference, $F(1, 328) = 4.592$, $p = .033$, $\eta^2 = .014$. Conversely, the content was perceived as having greater brightness when displayed against a white background ($M_{\text{white}} = 4.671$, $SD = 1.064$) compared to a black background ($M_{\text{black}} = 4.098$, $SD = 1.358$), with a highly significant difference, $F(1, 328) = 18.230$, $p < .001$, $\eta^2 = .053$. These results provide robust support for Hypotheses 1 and 2, establishing that background color significantly influences consumer perceptions of earnestness and brightness. The detailed results of the one-way ANOVA are summarized in Table 3.

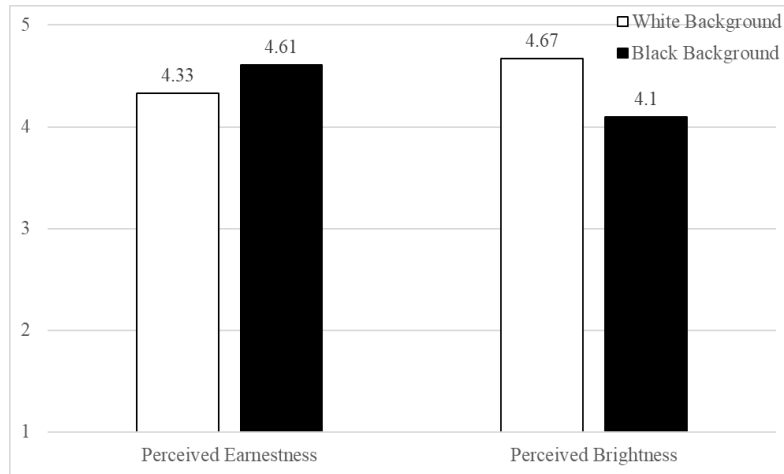


Figure 2. Perceived Earnestness and Brightness by Background Color Condition (White vs. Black)

Table 3. One-way ANOVA Results for the Effect of Background Color on Earnestness and Brightness

Variables	Background Color	N	Mean	SD	F	p	η^2
Earnestness	White	166	4.329	1.082	4.592	.033	.014
	Black	164	4.610	1.287			
Brightness	White	166	4.671	1.064	18.230	< .001	.053
	Black	164	4.098	1.358			

To assess the impact of perceived tone and mood on consumer attitudes toward the product, a multiple regression analysis was performed. The results are summarized in Table 4. Prior to analysis, diagnostic tests confirmed the absence of multicollinearity ($VIF < 2$) and autocorrelation (Durbin-Watson statistic = 1.751), validating the suitability of the model. The results showed that both earnestness ($B = .500$, $\beta = .431$, $p < .001$) and brightness ($B = .372$, $\beta = .336$, $p < .001$) significantly influenced consumer attitudes. Overall model fit was strong ($r = .694$, $r^2 = .481$, $\text{adj. } r^2 = .478$), and the regression was significant, $F(2, 327) = 151.82$, $p < .001$, demonstrating that brightness and earnestness—perceptual responses to background color—meaningfully shape consumer attitudes.

In summary, the findings confirm that background color plays a crucial role in shaping the perceived tone and mood of product detail pages. These perceptual responses—brightness and earnestness—serve as key mediators between design elements and consumer attitudes, underscoring the importance of strategic color design in mobile shopping environments. These results provide empirical support for the hypothesized perceptual effects of background color and reinforce the role of visual elements in shaping user interpretations.

Table 4. Multiple Regression Predicting Attitude

Variables	Attitude				
	B	SE	β	t	p
Constant	.476	.229		2.081	.038
Earnestness	.500	.060	.431	8.400	< .001
Brightness	.372	.057	.336	6.533	< .001
Model Fit	$r = .694$, $r^2 = .481$, $\text{adj. } r^2 = .478$, $F(2, 327) = 151.818$, $p < .001$				

To validate Hypotheses 3 and 4, which proposed differential impacts of background color perceptions based on participants' regulatory focus, a multiple regression analysis was conducted to examine the effects of earnestness and brightness on product attitudes. The Regulatory Focus Tendency Index was calculated by subtracting the mean score of the prevention focus items from the mean score of the promotion focus items. Based on this index, participants were categorized into two groups: 124 prevention-focused individuals and 102 promotion-focused individuals.

Focusing on the prevention-focused group, a multiple regression analysis was performed, and the results are summarized in Table 5. The analysis revealed that both earnestness ($B = .552$, $SE = .099$, $\beta = .435$, $t = 5.566$, $p < .001$) and brightness ($B = .346$, $SE = .083$, $\beta = .327$, $t = 4.186$, $p < .001$) significantly influenced product attitudes.

Standardized regression coefficients (β) are widely used in behavioral, marketing, and psychology research to estimate the relative influence of predictors measured on different scales (Kwan & Chan, 2011; Nieminen, 2022; Peterson & Brown, 2005). Based on these coefficients, earnestness showed a numerically larger β (.435) than brightness (.327), which may be descriptively interpreted as a stronger association with product attitudes. However, because relying on β values alone can be misleading—particularly when predictors are intercorrelated (Budescu, 1993; Johnson, 2000)—we performed a supplementary relative weights analysis (RWA) following Johnson's (2000) procedure. This analysis showed that the two predictors contributed equally (50 % each) to the explained variance. Although this pattern aligns directionally with Hypothesis 3, the result should be interpreted with caution given the converging evidence. Detailed regression results appear in Table 5.

Table 5. Multiple Regression Predicting Attitude (Prevention-Focused Group, $n = 124$)

Variables	Attitude				
	B	SE	β	t	p
Constant	.412	.439		.940	.349
Earnestness	.552	.099	.435	5.566	< .001
Brightness	.346	.083	.327	4.186	< .001
Model Fit	$r = .660$, $r^2 = .435$, adj. $r^2 = .426$, $F(2, 121) = 46.586$, $p < .001$				

To evaluate Hypothesis 4, which posited that a cheerful mood (brightness) would exert a stronger influence than a serious tone (earnestness) on product attitudes among promotion-focused consumers, a multiple regression analysis was conducted for the promotion-focused group. The results are summarized in Table 6. The analysis revealed that both earnestness ($B = .386$, $SE = .112$, $\beta = .352$, $t = 3.437$, $p < .01$) and brightness ($B = .501$, $SE = .119$, $\beta = .431$, $t = 4.208$, $p < .001$) had statistically significant positive effects on product attitudes.

While brightness exhibited a numerically larger standardized coefficient ($\beta = 0.431$ vs. 0.352), a supplementary relative weights analysis indicated that the two predictors contributed equally (50 % each) to the explained variance. These findings caution against inferring predictor dominance solely from β values and provide only descriptive support for Hypothesis 4. Detailed results appear in Table 6.

Taken together, the regression analyses and supplementary relative weights analysis demonstrate that both earnestness and brightness significantly influence product attitudes across regulatory focus groups. While the pattern of standardized coefficients aligns with the directional expectations of Hypotheses 3 and 4, the equal contribution of the two predictors to the explained variance suggests that their effects are comparable in magnitude. These results highlight the dual importance of perceptual cues in shaping consumer evaluations and provide descriptive, though not conclusive, support for the hypothesized moderating role of regulatory focus.

Table 6. Multiple Regression Predicting Attitude (Promotion-Focused Group, $n = 102$)

Variables	Attitude				
	B	SE	β	t	p
Constant	.420	.378		1.111	.269
Earnestness	.386	.112	.352	3.437	< .01
Brightness	.501	.119	.431	4.208	< .001
Model Fit	$r = .732$, $r^2 = .536$, adj. $r^2 = .527$, $F(2, 99) = 57.167$, $p < .001$				

5. Conclusion

This study's findings provide meaningful insights into the role of background color on product detail pages and its influence on consumer attitudes, as moderated by consumers' regulatory focus. The results from the multiple regression analyses conducted across different focus groups offer descriptive support for the hypothesized differential impacts of background color tone—Earnestness and Brightness—on attitudes toward the product.

First, the results from the general sample indicated that both a serious tone (Earnestness) and a cheerful mood (Brightness) significantly influenced consumer attitudes, with brightness showing a slightly larger standardized coefficient. This suggests that while consumers generally respond to the emotional cues provided by background colors, lighter and more vibrant tones may be perceived more favorably, although both dimensions play important roles. Further subgroup analysis revealed more nuanced patterns based on individuals' regulatory focus. Among prevention-focused consumers, earnestness exhibited a numerically stronger association with product attitudes than brightness, offering directional support for Hypothesis 3. Conversely, in the promotion-focused group, brightness showed a numerically higher beta coefficient, providing descriptive alignment with Hypothesis 4. However, in both groups, relative weights analysis revealed that earnestness and brightness contributed equally to the explained variance, suggesting that the observed directional differences should be interpreted with caution. These findings not only reinforce the observed empirical patterns but also connect meaningfully with existing literature.

The findings of this research both corroborate and extend existing literature in several important ways. Our results align with prior studies by Labrecque and Milne (2012) on color psychology in marketing contexts, which established that visual elements create subconscious associations that influence consumer judgments. However, our study extends this understanding by introducing regulatory focus as a moderating factor in the relationship between background color and consumer response—a connection that has received limited attention in previous research.

Similarly, while Deng and Poole's (2010) work on emotional responses to web interfaces identified the importance of color as an atmospheric cue, our findings offer a more focused view into how perceptual and motivational processes jointly shape consumer attitudes. Furthermore, our research complements more recent work by Jeong and Yeu (2023) on contextual backgrounds in e-commerce by providing a theoretical framework that explains how visual tone interacts with consumer dispositions, offering practical implications for segmentation strategies.

In summary, this research highlights the critical role of background colors on product detail pages and their capability to differentially influence consumer attitudes based on their regulatory focus. By integrating psychological insights into visual marketing strategies, businesses can significantly enhance consumer engagement and satisfaction.

One key theoretical implication of this study lies in the application of self-regulatory focus theory to ambient design elements in digital contexts. While prior research has primarily applied regulatory focus theory to verbal or explicit persuasive content, this study demonstrates that even subtle background elements such as page color can activate motivational congruence and shape attitudinal outcomes. This extends the utility of regulatory focus theory into a broader range of digital design decisions. For instance, prevention-focused individuals—typically risk-averse and oriented toward safety—may respond more positively to muted, earnest tones that imply stability. Conversely, promotion-focused individuals—who seek novelty and achievement—may be more engaged by brighter, more optimistic color schemes that signal dynamism and progress. This application highlights how motivational alignment between users and visual environments can facilitate more effective digital communication. It contributes to both consumer psychology and UX theory by showing that perceptual cues can operate as subtle but powerful design levers that influence user experience.

Secondly, it expands user experience design principles. Beyond the traditional focus on usability and functionality, this study proposes an expanded framework that incorporates psychological tailoring as a core component of user experience design. By integrating self-regulatory focus theory into UX design, designers can create experiences that resonate more deeply on an emotional level, transcending mere visual appeal and functional efficiency. This approach advocates for a design philosophy that emphasizes psychological congruence, where interface elements are not only visually organized but also psychologically aligned with users' motivational states. For instance, this could lead to adaptive design strategies where web platforms dynamically adjust their interface to match the regulatory focus of logged-in users. Such personalized experiences could significantly enhance user engagement, reduce cognitive dissonance, and promote greater satisfaction and loyalty.

The practical implications of this study are profound for marketers and web designers seeking to optimize digital environments for maximum consumer engagement. By understanding how consumers' regulatory focus influences their perceptions and interactions with product detail pages, designers can tailor these pages to specific consumer segments. For practical implementation, we recommend several specific strategies: First, e-commerce platforms should develop systems that classify users' regulatory focus based on browsing patterns and purchase history. This can be accomplished through machine learning algorithms that analyze indicators such as time spent examining product details (prevention-focused behavior) versus rapid browsing across multiple options (promotion-focused behavior). Second, designers should create dual templates for product pages—one featuring darker backgrounds with emphasis on product reliability, warranty information, and safety features to appeal to prevention-focused consumers; another utilizing brighter backgrounds that highlight innovation, aspirational benefits, and positive user experiences for promotion-focused individuals. This audience-matching logic aligns with Chen et al. (2022), who demonstrated

that tailoring social media brand-page cues to users' promotion- or prevention-orientations enhances brand loyalty; our mobile-PDP recommendations similarly adopt this fit-based approach. These design recommendations are consistent with our findings that both earnestness and brightness significantly influence product attitudes, though their relative effects may vary depending on consumers' motivational orientations. Third, A/B testing frameworks should be implemented to continuously refine the color schemes and content presentation based on conversion metrics from different user segments. Fourth, for platforms unable to personalize at the individual level, geographic and demographic segmentation can guide regional design variations, as research suggests cultural factors influence regulatory focus tendencies.

For prevention-focused consumers, employing a serious tone with more subdued and darker color schemes may enhance perceived reliability and trustworthiness. Conversely, for promotion-focused consumers, implementing brighter, more vivid color schemes may evoke feelings of optimism and positivity. While both perceptual cues were found to contribute equally to consumer attitudes in our analyses, the directional preferences observed suggest value in tailoring visual tone to motivational tendencies. This strategic alignment not only improves aesthetic appeal but also enhances the effectiveness of marketing messages, potentially leading to better conversion rates and customer retention.

The practical application of these findings extends beyond aesthetic considerations to impact fundamental business outcomes. Our analysis suggests that aligning background color tone with consumers' motivational orientation may contribute to improving conversion rates for targeted segments, based on perceptual responses associated with earnestness and brightness. Furthermore, the implementation cost of these design modifications is minimal compared to other marketing interventions, offering an attractive return on investment. Marketers can begin implementation by conducting preliminary segmentation of their customer base, testing background color variations in email marketing campaigns, and gradually extending successful approaches to product detail pages. This stepwise approach allows businesses to iteratively test, learn, and optimize their design strategies while minimizing operational risks.

Additionally, while both perceptual variables demonstrated equal predictive contribution in our relative weights analysis, the robustness of the overall regression models confirms the utility of the regulatory focus framework in digital marketing. This predictive power can be harnessed to develop advanced analytics tools for marketers, allowing them to more accurately predict and influence consumer behavior based on data-driven insights. By incorporating regulatory focus into behavioral models, digital platforms can create more personalized marketing strategies that are likely to resonate with different consumer groups. Furthermore, this approach can be extended to other aspects of digital marketing, such as personalized advertising and content recommendation systems, providing a comprehensive toolkit for marketers to enhance consumer engagement through psychologically congruent marketing practices.

Nevertheless, this study has several limitations that suggest opportunities for further research and refinement of the research model. First, the regulatory focus categorization employed in this study dichotomized respondents into promotion-focused and prevention-focused groups based on their questionnaire responses. While this approach provided clear comparative insights, it represents a simplification of what is likely a continuous spectrum of regulatory orientations. Future research could adopt more nuanced classification methods to capture intermediate regulatory states and examine how varying degrees of promotion or prevention focus might differentially influence responses to visual design elements.

Second, the visual stimuli in our experimental design were limited to a binary contrast between white and black backgrounds. This deliberate simplification, while methodologically sound for establishing foundational relationships, does not fully represent the complex color palettes employed in contemporary digital interfaces. Subsequent studies should expand the investigation to include varied color hues, saturations, and brightness levels to develop a more comprehensive understanding of how color properties interact with regulatory focus in shaping consumer responses.

Third, this study relies solely on experimental data. Future research should incorporate secondary data from mobile commerce platforms that utilize different background color designs. Analyzing actual user metrics—such as time spent on pages, conversion rates, and satisfaction scores—would validate whether our experimental findings apply to real-world shopping behaviors. Collaborative A/B testing with platforms could also examine how users with different regulatory orientations respond to various background colors in natural settings, potentially leading to more targeted design recommendations. Additionally, future studies could investigate potential moderating variables—such as product category, brand familiarity, or cognitive involvement—that may condition the relationship between background color and consumer attitudes. Exploring such boundary conditions would offer theoretical depth and clarify the contexts in which color-based effects are more or less pronounced.

Fourth, the cultural homogeneity of our sample presents another limitation. With participants exclusively drawn from South Korea, our findings may reflect culture-specific color associations and design preferences that cannot be generalized globally. Color symbolism and aesthetic preferences vary substantially across cultural contexts,

necessitating cross-cultural validation studies. Future research should incorporate multinational samples to identify both universal principles and culture-specific contingencies in the relationship between background color, regulatory focus, and consumer attitudes.

Finally, the experimental design carefully controlled for visual confounds. However, the potential influence of extraneous variables cannot be entirely eliminated. To minimize confounding effects, only the background color (white vs. black) was manipulated, while product images, pricing, layout, and text content—including font, size, and spacing—remained constant across conditions. A neutral-colored product image was selected to reduce interactions between background and product colors. Participants were randomly assigned to conditions to further reduce selection bias. This approach aligns with best practices in experimental design used in visual marketing research (Deng & Poole, 2010; Labrecque & Milne, 2012). Nevertheless, real-world shopping contexts involve inherent complexity. Future studies may consider using simplified stimuli, modeling potential confounds like text density or product hue as moderators, or adopting eye-tracking methods to better understand attentional focus during interface interaction.

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