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Decoding the Language of Lip Color: A Cross-Cultural Perspective

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1. Introduction

Functionality remains a cornerstone of cosmetic product development: a moisturizer must effectively hydrate, while a lipstick must provide desirable color. However, a growing awareness of the psychological and neurophysiological impact of cosmetics drastically changes this traditional focus on functionality [1]. Cosmetics are no longer solely for aesthetic modification of appearance; they can also influence emotions, mood, and self-perception [2]. This shift is reflected in both consumer demand and industry innovation: consumers increasingly seek products that enhance well-being [3], [4], while the industry explores new domains such as neurocosmetics, focusing on products that inherently promote positive feelings [5].

However, harnessing the emotional and physiological power of cosmetics requires a deeper understanding of the underlying mechanisms. The multisensory nature of our interaction with cosmetic products – via touch, sight, smell, and hearing – and its subsequent emotional impact is complex. Decoding the interaction with individual stimuli like color, texture, fragrance, and sound is challenging in itself. Furthermore, the combined influence of these stimuli creates a complex perceptual interplay, with each modality affecting the perception of others [1]. Therefore, neurophysiological methods are increasingly employed to study the nuanced emotional responses to cosmetic products [2].

Color is an inherent attribute of many cosmetic products, particularly makeup. In the dynamic landscape of the beauty industry, color wields significant influence, shaping consumer perceptions, purchase decisions, and emotional connections with brands [6]. Understanding how to leverage color not only for aesthetics but also to craft resonant emotional experiences is crucial. Moreover, public interest in the psychological and affective influences of color continues to grow, driving further scientific inquiry. Research on color-emotion correspondences, spanning over a century, has revealed distinct patterns of associations, with color categories linked to various emotions and systematic relationships observed with lightness, saturation, and hue [7]. However, it is important to note that much of this research has focused on abstract associations rather than the impact of color on real-world emotional experiences. While some studies have explored the neurophysiological impact of color in cosmetics, for instance,

relating color to willingness-to-pay [8] or autonomic nervous system responses [9], this area of research remains relatively unexplored.

A deeper understanding of the intricate relationship between color and emotions is needed, particularly regarding lip makeup. A previous study conducted in the US [10] pioneered the decoding of the link between lip makeup colors and positive emotions, utilizing a novel methodology that combined surveys with physiological measurements such as galvanic skin response (GSR), electroencephalography (EEG) and eye-tracking. This hybrid approach opened the door to understanding of the complex interplay between color, emotion, and consumer preferences. Expanding upon this initial research, the present study extends the investigation to China, recognizing the critical importance of cross-cultural comparison for developing globally relevant color palettes and targeted marketing strategies.

This research primarily aims to investigate the explicit and implicit emotional impact of digital lip makeup colors on Chinese consumers, identifying specific color families and shades that are associated with positive make-up relevant emotions. The findings hold significant implications for product development and contribute to a broader understanding of cross-cultural variations in color perception and emotional responses.

2. Materials and Methods

The methodology largely replicated the one from the original US study [10], with minor adaptations to ensure cultural relevance for the Chinese market.

Participants

The study involved 80 female participants residing in China, aged 18 to 40 years old. Participants were divided into two age groups (18-29 and 30-40). Skin tone was objectively measured using a spectrophotometer, and participants were categorized into three skin tone clusters (C1, C2, and C3, representing lighter, medium, and darker skin tones, respectively) following a patented procedure. Participants were recruited based on their interest in cosmetics and willingness to undergo a multi-sensory evaluation involving physiological measurements, after providing an informed consent.

Stimuli

Emotional Stimuli

Eighteen positive emotion words were used as stimuli (Fig. 1a). Fifteen of them repeated the emotional stimuli from the original US study: *Amazed, Casual, Daring, Energetic, Happy, Intrigued, Peaceful, Perfect, Playful, Relaxed, Secure, Self-confident, Sensual, Sophisticated* and *Trendy*. Based on the internal consumer market insights, three new positive emotion words were added due to their significance to the Chinese consumers: *Sweet, Romantic* and *Passionate*. All the words were carefully translated into Mandarin Chinese to ensure semantic equivalence with the original English terms.

Color Stimuli

The color stimuli selection process was adapted from the original US study. Shades deemed unsuitable for Asian skin tones were removed, and new, market-relevant shades were added. This resulted in a final selection of 174 shades, with 30 shades each in the red, purple, pink, orange, and brown families and 18 shades in the "other" category (encompassing less common lip colors such as blue, green, gold, etc.) (Fig. 1b).

Virtual Try-On (VTO) Stimuli

Three photorealistic avatars representing three skin tone variations (C1, C2, and C3, corresponding to the participants' skin tone clusters), were used for the VTO (Fig. 1c). Each of the 174 lip shades was digitally applied to each avatar using a patented algorithm.

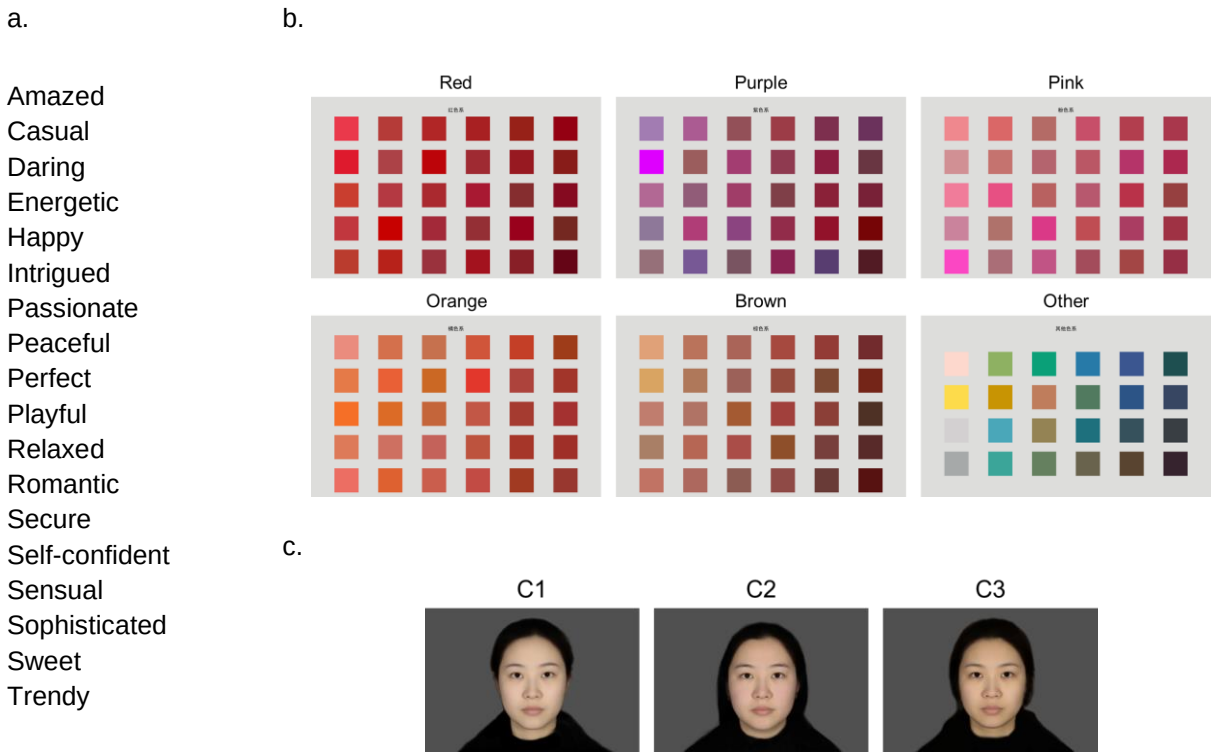

Fig. 1: Study stimuli. a. 18 words used as emotional stimuli; b. 174 shades of 6 color families used as color stimuli; c. avatars of 3 skin tones used for the VTO.

Protocol

The study was conducted using a digital platform that combined visual stimuli, real-time physiological measurements, and a survey. Visual stimuli were presented on a color-calibrated monitor against a neutral gray background (L = 88) to minimize color interference. Participants initially completed an EEG calibration task using emotionally evocative images to establish a baseline for their physiological responses.

For each participant, the main experiment consisted of four stages, repeated for nine randomly selected emotions (out of 18) presented in a random order (Fig. 2):

1. Emotion Elicitation
Participants were presented with an emotion word and performed a free-listing task, generating three words they associated with the presented emotion.

2. Color Family Selection
Participants viewed a color board containing five shades from each of the five color families (red, purple, pink, orange, and brown). They selected one or two color families they felt best represented the target emotion.

3. Shade Selection
Participants viewed a series of color boards, each displaying 30 shades from the selected families, one board at a time. For each board, they chose up to three shades most representative of the emotion. The shades on the boards were presented in a semi-randomized order, e.g., light to dark by row, light to dark by column, dark to light by row, dark to light by column. This method helped mitigate potential biases related to color arrangement.

4. Virtual Try-On (VTO) and Evaluation
The chosen shades were digitally applied to the lips of an avatar with a skin tone closely matching the participant's measured skin tone. Participants were presented with a survey to rate the desirability of each applied shade on a 0–5 scale (from 0 = “not at all” to 5 = “completely”) for liking, wearing intention and buying intention.

Stages 3 and 4 were then repeated for the board containing 18 shades of “other” color family.

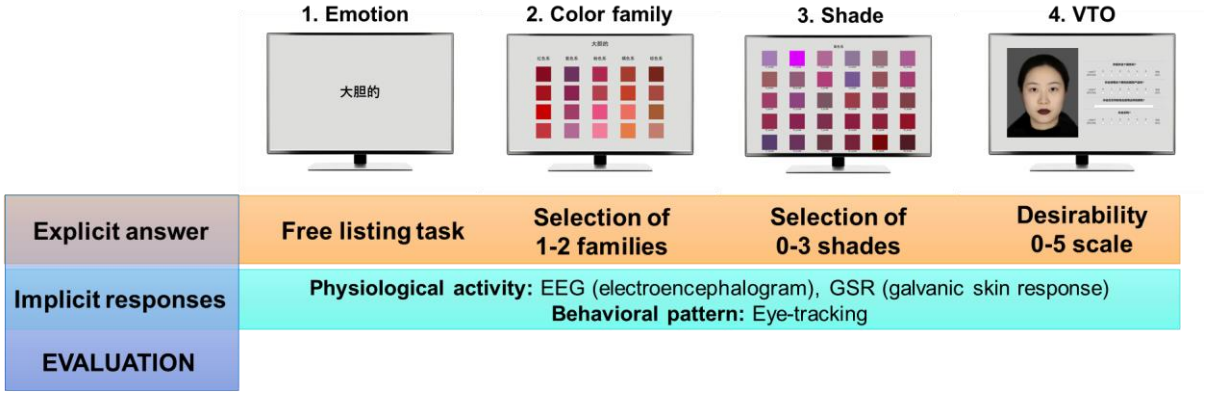

Fig. 2: Four stages of the protocol.

Physiological Measurements

Throughout the experiment, the following physiological measurements were recorded in real-time:

- electrodermal activity via galvanic skin response (GSR) to assess emotional intensity; for this, the number of GSR peaks representing arousals was calculated within 5 seconds following the presentation of a stimuli;
- electroencephalography (EEG) with 24 channels across the scalp to measure emotional valence and intensity; the emotional impact was calculated within 500 ms following the presentation of a stimuli;

- eye-tracking to capture visual attention (fixation points and dwell times on colors and avatars).

Data Analysis

An *Emotional Impact Score* was calculated for each shade based on the participants' verbal VTO ratings (liking, wearing, buying) and physiological responses (GSR, EEG). This score served as a metric for quantifying the emotional resonance of each shade. Further analysis focused on identifying colors that elicited both high verbal ratings and significant positive physiological responses.

3. Results

Color Choices per Emotion

For each emotion, representative color palettes containing shades with both high *Emotional Impact Scores* and positive VTO rankings were built, ensuring congruence between implicit physiological responses and explicit verbal preferences. Comparison with the color palettes from the US study revealed both cultural similarities and differences in color-emotion associations. For example, *Happy* was mainly linked to reds and oranges in China. The US consumers shared the preference for reds, however, it was complemented by pinks and purples instead of oranges (Fig. 3a and 3b). Conversely, both cultures associated *Peaceful* with mainly brownish hues (Fig. 3c and 3d).

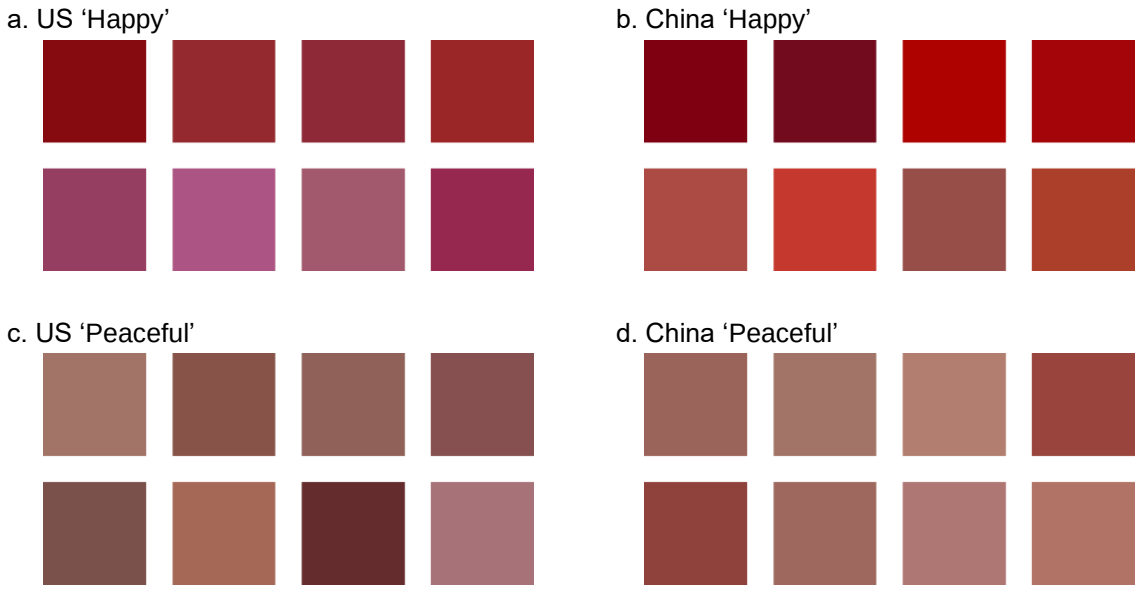

Fig. 3: Examples of color palettes; a, b. *Happy* palette for the US and China, respectively; c, d. *Peaceful* palette for the US and China, respectively.

VTO Evaluation and Color Rejection

Only 36% of the shades initially chosen on the color boards (stage 3 in the protocol) received positive VTO ratings (liking of 4 or 5) (stage 4 in the protocol), compared to 55% in the US study. This indicates a more critical evaluation of the VTO stimuli among Chinese participants, reflected in the lower average liking score (2.4 ± 1.8 in China *vs*. 3.3 ± 1.8 in the US). Of the shades that received positive VTO liking scores, only 45% (representing 16% of the initial shade selections on the color boards) also evoked a positive implicit emotional response, as measured by GSR and EEG. These proportions were higher in the US study (36% and 20%, respectively). Similarly, while 54% of the verbally rejected VTO shades (19% of initial selections on the color boards) evoked a negative implicit emotional response in the China study, this was true for 40% (8% of initial selections) in the US study. These results are schematically summarized in Fig. 4.

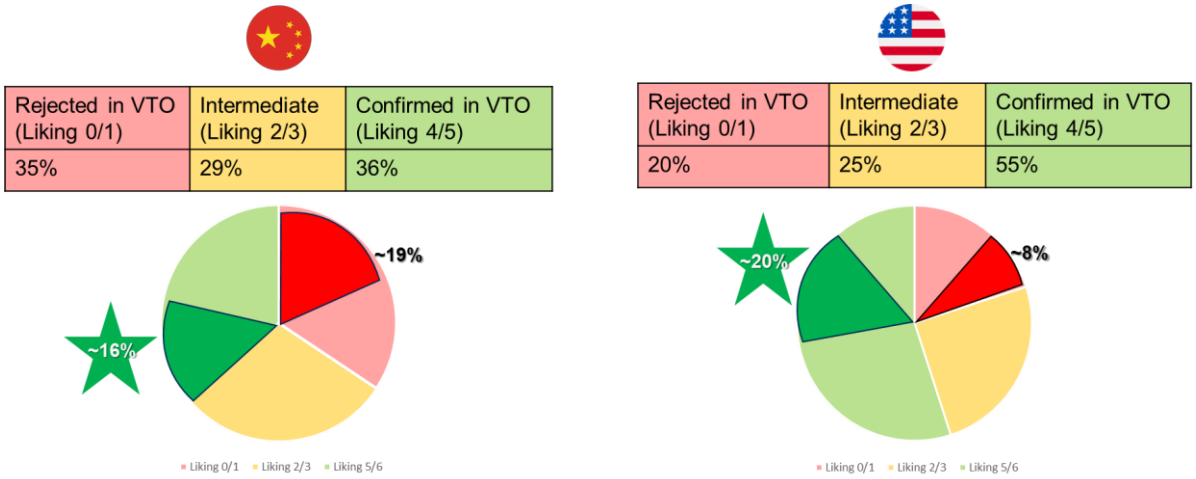

Fig. 4: Explicit (verbal) and implicit (physiological) assessments of the VTOs, presented as tables and pie-charts. 100% or each pie represents the total numbers of shades initially chosen on the color boards. On the pie-chart, the bright green/red portions indicate shades liked/disliked verbally that also evoked a congruent positive/negative physiological response. Results for China (left) and the US (right) are displayed.

Impact of Emotional Words

Analysis of *Emotional Impact Scores* indicated that *Trendy* and *Sophisticated* evoked the strongest physiological reactions, while *Happy* and *Relaxed* were among the least impactful. This contrasts with the US study, where *Relaxed*, *Happy*, and *Perfect* elicited the strongest responses, and *Sophisticated* was among the least impactful.

Color Family Preferences

Red remained the most chosen color family in both the US and China studies. In China, purple and brown were the least preferred, while orange was the least preferred in the US. Importantly, colors outside the typical lip color range (“other” category, including blue, green, gold etc.) were not chosen by Chinese participants for any of the tested emotions, unlike in the US study.

Color-driven Visual Attention

Eye-tracking data revealed that highly saturated pinks and purples initially captured the most visual attention and were often selected in the first stage of the color selection task. However, these same colors received low desirability ratings (0 or 1) in the VTO evaluation phase, a pattern mirroring the US study results.

4. Discussion

This study investigated the complex interplay between color, emotion, and consumer preference, specifically in the context of lip makeup for Chinese consumers. By integrating explicit measures (surveys) with implicit physiological data (GSR, EEG, and eye-tracking), we achieved a better understanding of the emotional impact of color and its influence on product desirability. This research builds upon a previous US-based study [10], providing a cross-cultural perspective on color-emotion associations in two key cosmetics markets. A key contribution of this research is the expansion of the *Emotion <-> Lip Color Toolbox*, encompassing color palettes associated with 18 positive emotions based on both physiological and verbal responses, which now includes data from both US and Chinese consumer groups. This toolbox provides a scientific foundation for developing emotionally targeted lip shade portfolios, offering actionable insights for product development.

Our findings highlight the complexity of color-emotion associations. While previous research suggests some universal associations at mainly an abstract level [11], this study reveals significant cultural variations in color choices between the American and Chinese consumers. The complete rejection of the "other" color family by the Chinese participants further emphasizes the importance of cultural context in color perception. This aligns with research demonstrating that color semantics plays a crucial role in how individuals interpret and interact with the world around them [12]. Moreover, the importance of each emotion was not the same in the two countries, suggesting that cultural context significantly influences not only color preferences, but also the relative emotional weight assigned to specific emotions.

The substantial rejection rate of initially chosen colors during the VTO phase (34% in China, 20% in the US) further underscores the role of context. As highlighted in [1], the multisensory experience of a cosmetic product, including the visual contrast with skin tone and overall facial appearance when viewed in the realistic context of a VTO, can significantly alter perceptions of desirability. This explains, in part, the rejection of initially appealing, highly saturated pinks and purples in the VTO phase, where the dissonance between expectation and the perceived reality of wearing such bold shades likely led to lower ratings. Moreover, the observation that only a part of "liked" VTO colors elicited congruent positive physiological responses reinforces the findings in [2] about the need for implicit measures. These data suggest that explicit preferences may not fully capture the complex emotional responses to color, reinforcing the value of incorporating physiological data.

Interestingly, red emerged as the preferred color family in both cultures. Though it is aligned with its established historical association with beauty and femininity [13], this observation seemingly contradicts current market trends favoring "no makeup makeup" and nude lip

shades. This discrepancy may be attributed to the study design: explicitly prompting participants to consider colors through the lens of emotions like *Daring* or *Intrigued* could have biased selections away from more neutral hues. It's plausible that under different framing conditions (e.g., everyday wear, natural look), color preferences might align more closely with current market trends. Further research is needed to investigate how contextual factors and explicit emotional framing influence color choices in cosmetics.

This study has limitations. While the broad selection of lip colors provided valuable insights, a comprehensive analysis of every possible shade remains impractical. Developing more efficient methods, such as predictive models based on these initial findings, is an area for future research. Investigating the underlying reasons for color rejection in the VTO phase could further refine these models. For example, exploring the interplay between individual skin tone, perceived contrast with the chosen shade, and overall facial harmony in driving rejection choices could provide valuable data for model development.

Beyond improving predictive capabilities, expanding the scope of investigation to encompass a wider range of cosmetic products and sensory modalities is critical. For example, understanding how color impacts emotional responses to products like eyeshadow or blush could provide a more holistic view of color's influence in the beauty industry.

Finally, as discussed earlier, cultural context significantly shapes color preferences and meanings. This cultural divergence likely stems from varying beauty standards and social norms. Therefore, future research should investigate the cultural significance of specific color families in various cosmetic categories across different geographic regions. These insights would be valuable not only for product development and marketing but also for understanding the broader cultural context of beauty and self-expression. Investigating how different VTO presentation modes (e.g., video, augmented reality) influence color evaluation and how these digital experiences compare to real-life product application is another promising avenue for future research, considering the increasing prevalence of digital tools in beauty and cosmetics.

5. Conclusion

This research compares emotional response to lip color between Chinese and American consumers. Using a combination of explicit verbal and implicit physiological measures, we investigated how Chinese women connected positive emotions to digital lip shades. Findings revealed the importance of cultural and emotional contexts in shaping lip color preferences, with implications for global product development strategies. Further research is needed to explore the broader implications of these findings and refine the methodologies for capturing and analyzing multi-sensory emotional responses in the context of cosmetics.

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