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FACIAL SKIN**

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PREFERABLE LIGHTING FOR APPEARANCE OF WOMEN'S FACIAL SKIN

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Abstract

This study aims to reveal the preferable lighting condition on the appearance of woman's facial skin. We conducted an experiment on the appearance of woman's face with and without makeup under some lighting conditions. The facial skin conditions of the female model consisted of three patterns, without makeup, with makeup in orange and with makeup in pink. Participants evaluated face appearance in terms of "naturalness," "activity", "sophistication" and "preference". According to the results, the facial skin without makeup and with "natural" makeup look good under 4000K and 5000K in negative duv , and facial skin of all types looks active under 3000K. In addition, the evaluations of activity of the face without makeup correlated with the preference index for Japanese complexion PS , whereas other evaluations of preference have no correlation with PS .

Keywords: Light color, appearance, Makeup, Facial skin

1 Introduction

The appearance of the skin is extremely important for women and various products aim at improving the skin condition. However, the appearance of the facial skin depends on the lighting as well as on the cosmetics being applied. Indeed, cosmetics can alter the perceived color of the skin which affects the visual evaluation.

Previous our study reported that some LED lamps with low color temperature is better for perceived impression of a woman's face when compared to high color temperature LED lamps (YAMAGUCHI, et al., 2012). Also, we found the optimal combinations of the light color and the type of makeup that were preferred on the appearance of woman's facial skin (OKUDA, et al., 2017). On the other hand, it was reported that a preference index PS for Japanese women complexion (YANO, et al., 1998) was suitable for evaluating appearance under various kinds of light sources including fluorescent lamps defined by CIE15.3, 2004 and LED lamps, white LEDs and RGB LEDs (YANO, et al., 2016).

To reveal the preferable lighting condition on the appearance of woman's facial skin, we conducted an experiment on the appearance of woman's face with and without makeup under some lighting conditions with different correlated color temperature (CCT) and distance to the blackbody locus (duv).

2 Methods

2.1 Visual stimuli

First, we set 20 kinds of lighting conditions with four levels of CCT (3000K, 4000K, 5000K, 6700K) and 5 kinds of duv (-0.010, -0.005, 0, +0.005, +0.010) in each CCT condition, using 6 RGB LED lamps [iColor Cove MX Powercore, Philips Color Kinetics] and 10 white LED lamps [iW CoveMX Powercore, Philips Color Kinetics] with 3 kinds of LED in different correlated color temperature. Table 1 shows the color rendering characteristics: R_a (CIE CRI), R_{15} (for Japanese complexion, JIS), R_f (CIE 224) and PS (Preference Index of Japanese complexion) of each lighting condition.

Secondly, we asked a female university student to be a model as the visual object. She was 22 years old. Her facial skin colors with and without cosmetic foundation and the average of Japanese women's facial skin colors with cosmetic foundation in 2011 were shown in Table 2.

We prepared three patterns of facial skin, without makeup, with “natural” makeup in orange lipstick and brusher and with “cute” makeup in pink lipstick and brusher. Figure 1 shows the faces with three patterns of makeup under the lighting conditions, where $CCT=5000K$ and $duv=0$.

Table 1 – Color rendering characteristics: R_a (CIE CRI), R_{15} (for Japanese complexion, JIS), R_f (CIE 224) and PS (Preference Index of Japanese complexion)

Lighting Conditions	CCT (K)	duv	x	y	u'	v'	R_a	R_{15}	R_f (CIE224)	PS
3000K-10	3004	-0.010	0.423	0.376	0.254	0.507	75	80	85	88
3000K-05	2997	-0.005	0.430	0.390	0.252	0.515	86	88	89	94
3000K	3005	0.000	0.436	0.403	0.251	0.521	91	82	89	90
3000K+05	2996	0.005	0.445	0.421	0.249	0.529	91	88	80	95
3000K+10	3008	0.010	0.453	0.436	0.247	0.536	88	85	78	94
4000K-10	3999	-0.010	0.374	0.352	0.231	0.489	96	94	90	98
4000K-05	4003	-0.005	0.377	0.364	0.228	0.495	96	94	89	95
4000K	4004	0.000	0.380	0.376	0.225	0.501	87	89	88	90
4000K+05	3998	0.005	0.384	0.391	0.222	0.508	86	90	89	89
4000K+10	4006	0.010	0.387	0.402	0.220	0.513	86	91	90	90
5000K-10	5003	-0.010	0.343	0.331	0.218	0.474	88	94	91	97
5000K-05	4997	-0.005	0.344	0.341	0.215	0.479	96	96	91	93
5000K	4997	0.000	0.345	0.351	0.212	0.485	91	91	89	84
5000K+05	4992	0.005	0.346	0.363	0.208	0.490	88	91	90	83
5000K+10	4993	0.010	0.347	0.374	0.205	0.495	87	91	90	82
6700K-10	6693	-0.010	0.313	0.305	0.208	0.455	82	89	87	95
6700K-05	6707	-0.005	0.312	0.312	0.204	0.459	89	94	88	83
6700K	6703	0.000	0.311	0.321	0.200	0.464	94	92	88	90
6700K+05	6699	0.005	0.309	0.329	0.196	0.468	92	94	88	80
6700K+10	6699	0.010	0.308	0.337	0.192	0.472	91	94	89	79

Table 2 – Facial skin colors with and without cosmetic foundation and the average of Japanese women's facial skin colors with cosmetic foundation in 2011

Visual targets	skin condition	Hue	Value	Chroma	Melanin Index
Woman's model of this experiment	nude	8.2YR	6.59	3.09	0.93
	with cosmetic foundation	6.2YR	6.45	3.51	1.25
Woman's model of the experiment reported in CIE2017	nude	8.3YR	6.46	2.95	1.10
	with cosmetic foundation	6.9YR	6.47	3.17	1.14
Average of Japanese women's skin in 2011*	with cosmetic foundation	5.6YR	6.91	3.54	1.14

Figure 1 – Faces with three patterns of makeup (5000K, $duv=0$)

2.2 Procedure

Figure 2 shows the experimental space. Participants observed the lower half of the female model's face, especially the lower cheeks, and evaluated “naturalness,” “activity,” “sophistication” and “preference” with a numerical scale from -10 (bad) to +10 (good). Fifteen females in their twenties participated, and all had normal color vision.

Figure 2 – Experimental space

3 Results and Discussion

Figure 3 shows the evaluation results. The evaluations of “naturalness,” “sophistication” and “preference” were relatively high under the lighting conditions of 4000K and 5000K in $duv=-0.005$ but relatively low under the lightings of 3000K in all types of facial skin. On the other hand, the “activity” was quite high under the lighting conditions of 3000K whereas the facial skin under 6700K lighting looks inactive. The lighting conditions in $duv=+0.01$ were relatively low in all types of facial skin. As compared with the patterns of facial skin, the evaluations of facial skin without makeup were similar to those of facial skin with “natural” makeup.

Figure 4 shows the relationship between the evaluation results and PS . It is clear that the evaluations of the activity of facial skin without makeup are correlated with PS , but evaluations of preference are not correlated with PS .

Figure 3 – Evaluation results

Figure 4 – Evaluation results

Moreover, we analyzed these evaluation data by using a multiple regression; “preference” was used as the response variable, and “naturalness,” “activity” and “sophistication” were used as the explanatory variables. As a result, it was derived that the standardized partial regression coefficient of “sophistication” was 0.663, that of “naturalness” was 0.282, and that of “activity” was 0.128. This suggests that the contribution of “sophistication” is much higher than that of “naturalness” or “activity” in “preference” evaluation.

4 Conclusion

Facial skin without makeup and with “natural” makeup look good under 4000K and 5000K in negative duv , and facial skin of all types looks active under 3000K. In addition, the evaluations of activity of the face without makeup correlated with PS, whereas other evaluations of preference have no correlation with PS.

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