

Models for Understanding & Predicting Consumer Perception of Radiance

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INTRODUCTION

Products that deliver an immediate appearance benefit in terms on improvement to skin appearance are important to skin care products. The performance of glow & radiant skin has been identified as end benefit.

Previous research studies have identified key components of Radiance/Glow to be Skin Color, Skin Condition, and Skin Texture. We know that consumer perception of radiance is not based on a single parameter but is a composite of a number of different appearance attributes

Our working hypothesis details this even further and states that radiance may be comprised of 4 components, Color, Evenness, Texture, and Shine

OBJECTIVE

An attempt to understand "natural radiance" obtained through photo evaluation via its relationship to quantitative parameters culled from image analysis, and color measurements on groups of women ages 20-60 in both Thailand and China.

METHODS

The data used for both China and Thailand came from studies where photo's were taken approximately 20 minutes after subjects washed their face to insure that as consistent as possible a baseline for assessing natural radiance was achieved.

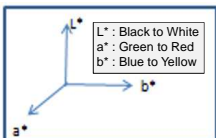
In both countries subjects in the age range of 20-60 were recruited.

After washing their faces, face photos were taken of each subject under controlled lighting & camera setting conditions. In addition spectral data was collected using the 2600D spectrophotometer.

Subsequent to the collection of photos for all subjects, each subject was brought back and asked to evaluate their own photo as well as the photos of all other subjects presented using a carry over Latin square design in a controlled setting with calibrated monitors. Subjects evaluated the photos on a seven point scale intensity scale (Not Radiant / Dull at all to Extremely Radiant / Dull) for Radiance and Dullness.

A number of image analysis algorithms have been developed to quantify various skin related attributes. In addition to the consumer data and in-vivo data some of the image analysis algorithms were used to compute parameters for spots, blemishes, and texture.

The color parameters L*, a*, b* were extracted from the spectral data.



DATA ANALYSIS METHODOLOGY

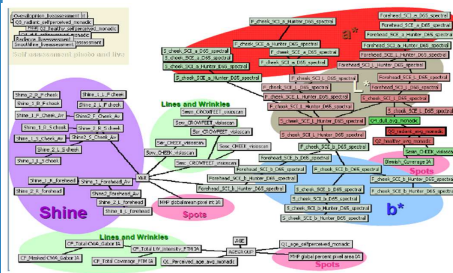
A variety of analyses techniques were employed to understand the relationships between consumer perception and the quantification of attributes.

1. Bayesian nets : To gain a sense of the overall structure and relationships in the data which gives high level understanding of the appropriateness of our hypothesis and helps with variable selection.
2. The primary model building tool used was Partial least squares analysis to develop and refine the final models.

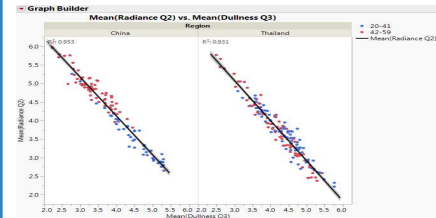
In building the PLS models both statistical significance of the model coefficient in explaining the depended variable and the Variable Importance Projection (VIP) were used as factors in model pruning. K-fold cross validation methods & partitioning into training (80%) and validation (20%) were used to statistically validate the models.

DATA ANALYSIS

After merging all data the first analysis conducted was a Bayesian Graphical Network analysis to identify the general product structure and gain a first level understanding of relationships.



Relationship between Radiance & Dullness for both countries.



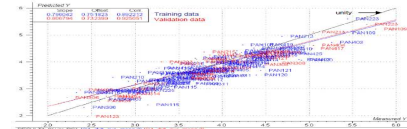
Based on the high correlation of radiance & dullness in both Thailand & China and as model was explained better with dullness it was decided to focus on dullness predictions

PLS was used to model the relationship between Dullness / Radiance and the measurement parameters. Both Unscrambler(18) and XL-Stat(19) were used in developing the models. Cross validation was conducted in Unscrambler.

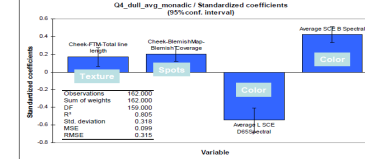
DATA ANALYSIS

THAILAND

Thailand : Actual vs Predicted Perceived Dullness (Cross Validation)



Thailand Model: Standardized Coefficient

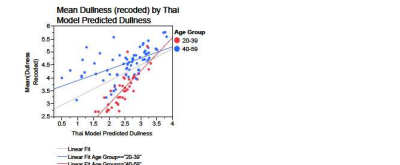


Thailand: Model suggests that color is a major driver of radiance/Dullness perception for Thai people followed by spots and potentially texture.

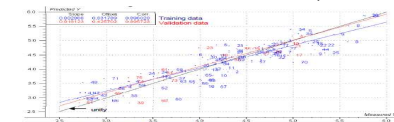
CHINA

Applying the Thai model to China shows varying results by age group indicating that the younger population in China is more similar to Thailand. This led to the hypothesis that we might need to include age as a covariate or build 2 separate models in China to account for differences in age group.

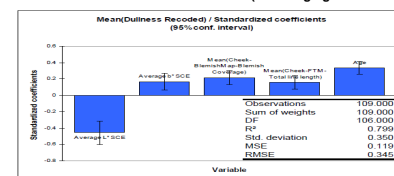
Relationship between actual photo assessment for Radiance / Dullness and Thai Model Predictor scores



China : Actual vs Predicted Perceived Dullness (Cross Validation)



China Model: Standardized Coefficient (Including Age as covariate)



RESULTS

1. Perceived Radiance/Dullness in both countries appears to be related to color, spots, and texture however the balance of the contribution of each of these appears to be different between the two countries with increased focus on Spots and Texture in China.
2. In both countries L* is a key contributor to the perception of Radiance/Dullness with increasing L* (lighter) related to increased perception of Radiance and decreased perception of dullness.
3. Additionally b* appears to play a larger role in Radiance/Dullness perception in Thailand than it does in China though the direction of relationship is similar in both countries i.e., increases in b* (more positive values – i.e. more yellow) related to decreased Radiance perception and increased Dullness perception
4. Inconsistent with our initial hypothesis, Shine does not appear to be a major contributor to radiance / dullness perception as evidenced by the models as well as the location of shine in the Bayesian Net work.

CONCLUSIONS

In both countries models with R² values of around 0.8 were obtained. Both Models have highlighted some distinctions as well as similarities between Thailand & China.

While residual plots indicate that there is still some level of systematic variation not accounted for in the models. This work has proven to be very helpful in understanding & defining in technical terms consumer perception of radiance / dullness. The models have also been successfully used in predicting product performance & driving product development / claims.

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DISCLOSURE

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