A GENERAL LEXICON FOR SENSORY ANALYSIS OF TEXTURE AND APPEARANCE OF LIP PRODUCTS

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ABSTRACT

Lip products (lipsticks, glosses and balms) are an important aspect of the cosmetics business. The lip product segment of the business has been expanding because the majority of women use some form of lip products. In addition, men commonly use lip balm in winter months. The purpose of this 3-part study was to develop a lexicon for descriptive sensory testing of lip products. In the first study, two focus groups were conducted to understand women's perceptions of lip products, and elicit desirable and undesirable characteristics in the products. In the second study, six highly trained panelists from the Sensory Analysis Center at Kansas State University developed a lexicon using five samples each of lip balms, lip glosses, and lipsticks. All attributes were measured during or after application. Attributes were categorized under "initial texture", "initial appearance", "after appearance" and "after texture." The lexicon comprised of 18 terms. The panelists developed definitions, references, and protocols for evaluation for each attribute in the lexicon. The third study consisted of a validation phase, in which 12 samples, four from each product segment, were used. The lexicon developed in this study was inclusive enough to show distinctions between and within the lip glosses, lip balms and lipsticks. This lexicon could be used to identify similarities and differences in other lip products such as lip plumper, lip liners and multi-use products.

Keywords: lip products, focus group, lexicon, descriptive analysis

PRACTICAL APPLICATIONS

The lip product lexicon may benefit researchers and cosmetic companies in product development and optimization, quality control, and marketing by providing accurate definitions, accessible references, and reproducible protocols and techniques. Aspects of this research, including the use of photographic references, where appropriate, could be extrapolated to other aspects of the personal care industry, such as hair care and skin care, and can aid in product development and product optimization.

INTRODUCTION

Color cosmetics are considered by women to be essential beauty items – one of the few remaining affordable, non-invasive beauty treatments. As of November 2005, global cosmetic sales were ~$32.7 billion. Increases in global sales are fueled, in part, by emerging markets such as Eastern Europe, India, China and Latin America. Eastern Europe has shown sales growth for five consecutive years for an average annual increase of 10.2% (Horne 2005). As of 2006, lip products were the third largest segment of cosmetics (Datamonitor 2006). The lip product category is important worldwide with growth in various segments of the category depending on region (Feller 2005; Horne 2005; Prance 2007).

Textural differences in lipsticks, lip balms, and lip glosses occur because of their formulation, ingredients, and packaging form. Over 10,000 raw materials are listed in the dictionary of the Cosmetics, Toiletries and Fragrance Association (Castro 2006). Ingredients include waxes (for shape and application), oils (including olive oil, mineral oil, petrolatum, etc.), pigments, and emollients. Extensive research on women and color cosmetics has been conducted, connecting make-up application to self-esteem, confidence and beauty (Ogilvie and Kristensen-Bach 2001). The conclusion to these studies is the belief that image and beauty are enhanced through color cosmetics (Mulhern *et al*. 2003). Aside from the outward appearance reflecting inner confidence, it is important to understand what causes women to choose a certain product over another. A major difference between lipstick and lip gloss is the presence of pigment in lipstick to give it color. Lip glosses give a translucent and wet look to the lips when applied. Lip balms usually come in medicated form that is mainly used to treat chapped/cracked/dry lips (Brown 2002; Ellis-Christensen 2003).

Few sensory lexicons appropriate for cosmetic products have been published and those have been proposed for skin creams and lotions (Civille and Dus 1991; ASTM E 1490-92 1997; Wortel and Wiechers 2000; Lee *et al.* 2005). A lexicon was developed by Wortel and Wiechers (2000) on the sensory skin performance of personal care ingredients and products. Quantitative Descriptive Analysis® was used to categorize the terms under three major categories – 1) Before rubbing, 2) During rubbing, and 3) After rubbing. The authors observed that more descriptors were required to characterize the marketed products as compared to the ingredients. Lee *et al.* (2005) developed a lexicon for aqua cream. In general, 26 attributes were used to describe the various creams and lotions, including categories of attributes associated with 'appearance', 'pick-up', 'rub-out', 'after-feel (2 min)', and 'after-feel (10 min)'. Several of those lexicons included terminology, definitions and references with intensities for those products. In addition, several authors have used a limited number of attributes to describe oleogels and emollients used in lip and skin care products (Parente *et al.* 2008; Almeida *et al.* 2008). In those studies several attributes associated with appearance, pickup, rub-out, and aftereffects were used to study the products.

Some terms from prior studies may be appropriate for lip products, but no application of descriptive sensory analysis was found applied to lip products. Although cosmetic companies may have developed internal lip product lexicons that information is not published. Therefore, the overall objective of this study was to develop a lexicon (appearance and texture) for lip products which could be used for a wide range of products. The study was done in three parts: 1) a focus group to understand key attributes, 2) development of a lexicon for use by a trained sensory panel, and 3) confirmation of whether the lexicon could be used effectively for new samples and by new panelists.

EXPERIMENT 1 – FOCUS GROUPS TO DETERMINE CHARACTERISTICS OF LIP PRODUCTS

The specific objective of this part of the study was to understand the reasons why women purchase and wear lip products, and what attributes are desirable and undesirable in those products.

Materials and Methods

Recruitment. Only female participants (ages 18-60) who used at least two types of lip products were selected for the focus groups. Filler questions were included so the applicant would be unsure what the tested product was to be and their answers would be as honest as possible (Resurreccion 1998). Each participant was asked to bring the lip products that she currently used as examples and to help generate discussion. Approximately one half of the participants used their lip products more than once per day; approximately one-third used lip products about once per day. The remaining participants used lip products less than once per day, but more than once a week. The majority of the women purchased a new lip product at least once a month.

Methodology. Two, 90-minute focus groups were conducted by a professionally trained moderator from the Sensory Analysis Center at Kansas State University, who has prior experience conducting more than 100 focus groups. Each focus group session was audio-recorded and a note-taker was present. The discussions were held around a large round table in a room designed for focus groups that was well lit (natural and fluorescent lighting) and was temperature (22 ± 1C), humidity (~55%), and noise controlled. The moderator's guide began with general questions about make-up use, and then became more specific with questions about lip products and why the women use products on their lips. The women were asked to list five

positive characteristics of a lip product and five negative characteristics; a description of the panelist's ideal lip product; and brand names of products that they felt would represent the range of lip products available to them.

Results and Discussion

The idea of a perfect lip product varied from person to person, but the main theme was a clear/sheer/neutral colored, smooth, not sticky, moisturizing and flavorless/tasteless lip product. This parallels the consumer expectations for a lip gloss as observed by Williams and Schmitt (1992). Some women wanted a long-lasting color that does not smear or rub off. Lasting color is a desired property of a lipstick and not rubbing off is a popular consumer expectation along with easy application, natural look, moist feel, no bleeding, cracking or peeling, an acceptable flavor/fragrance, and lasting at least three to four hours (Williams and Schmitt 1992).

Positive characteristics of lip products according to women in our focus groups included color, glossy, long-lasting, moisturizing, shimmer, glide, and slipperiness (Table 1). Some women did not want any aroma or flavor whatsoever, while the majority did not mind if the product had an aroma or flavor as long as it was pleasing (which varied from woman to woman).

Undesirable lip product traits (Table 1) mentioned by both groups were sticky and drying. Additionally, anything that was gritty, crusty, gooey/gummy, dull, or staining that could interfere with later color applications. The women tended to think that lipsticks were the most likely to crack or "feather", so most would put a gloss on top of the color. It was mentioned that some lip balms would accumulate an undesirable waxy residue on the lips after consistent use.

Categories of sensory attributes for lip products suggested by the participants included appearance, texture and after removal. A list of these categories with associated attributes is shown in Table 1. In the subsequent part of this study (experiment 2), only appearance and

texture terms were considered for the development of the lexicon. In the 'after removal' category, attributes would be evaluated after wiping off the product, rubbing off the product, or once it has disappeared on its own. The product can leave a faded color on the lips ("staining"), remove the moisture from the lips and cause a pruning effect ("drying"), or leave a moist feeling ("moisturizing"). Some after effect attributes such as the lingering color intensity can be evaluated at any time or multiple times after application, while others that were of interest, such as drying and moisturizing, are skinfeel attributes have already been described in other literature such as the ASTM guide for Descriptive Skinfeel Analysis of Creams and Lotions (ASTM E 1490-92 1997).

EXPERIMENT 2 – LEXICON DEVELOPMENT FOR LIP PRODUCTS

The specific objective of this experiment was to develop a lexicon (appearance and texture attributes only) that could be used for descriptive analysis of lip products, mainly, lip glosses, lipsticks and lip balms.

Materials and Methods

Panelists. Six highly trained panelists from the Sensory Analysis Center at Kansas State University (Manhattan, KS) were selected for the lexicon development. Each panelist had over 120 h of general descriptive analysis training and over 1,500 hours of descriptive sensory experience, including testing non-food products such as skin cream, lotions, soaps and perfumes.

Products. Fifteen lip products were selected from various lip categories: balms, glosses, and lipsticks. Different colors, brands, packaging, price points, and claims were used to achieve a range of products. Table 2 details the products used for the lexicon development along with some relevant information about the products. All samples were commercially available and

purchased locally. Products were stored at room temperature (22C ± 1C) and kept out of direct sunlight.

Development of Definitions and References. Seven sessions of one and a half hours each were used to develop the lexicon. These sessions occurred in a climate- (22 ± 1C temperature and 55% relative humidity) and noise-controlled room. During this time, application and evaluation techniques for each attribute were developed. The lexicon focused on appearance and texture attributes only. Flavor and aroma characteristics, which can vary widely especially in flavored products, were not considered for this study.

The general lexicon development procedure was adopted from the flavor profile method (Caul 1957; Keane 1992). This procedure and the development of defined lexicons has been used in other lexicon or terminology development studies (Caul 1957; Keane 1992; Lee *et al.* 2005; Lee and Chambers 2007; Castillo *et al*. 2008; Hongsoongnern and Chambers 2008; Drake *et al.* 2007; Karagul-Yuceer *et al.* 2007; Retiveau *et al.* 2005). The ASTM International document on Standard Practice for Descriptive Skinfeel Analysis of Creams and Lotions (ASTM E 1490-92 1997) was used as a guide for panel training, orientation and testing for the lexicon development in this study. This included sample preparation, skin preconditioning, preparation of test area, and sample application. The panelists discussed several categories of attributes and many terms within each category. Initial terms and categories suggested are detailed in Table 3. All terms, definitions, references, and protocols were decided through consensus among the panelists.

Any products in stick form or with an applicator were applied as directed. Products in pots/tubs were scooped out with a plastic knife and applied the same way as lipsticks, wand applicators, or squeeze tubes. It was decided that testing should be done primarily on the inside

forearm or fingertips and a few attributes evaluated on paper. If the products were to be applied to the panelist's lips, only one to two product could be tested each day. Any more than one product would result in the panelist wiping their lips to remove the product, thereby creating a different environment for the next sample. The inside forearm had a larger area for application of the products. Prior to testing, each forearm was marked with three 2″ × 1 ½ ″ rectangular areas. This allowed specific areas for testing and three products could be tested on each forearm. For paper, a 1″ × 1″ grid was made using Microsoft Excel 2000 on tan colored paper (Item #10286-3; Hammermill® International Paper, Memphis, TN). The panelists found it was easier to see color variations on very light beige paper as opposed to bright white.

The panel developed evaluation techniques for each attribute. Initially all the attributes were evaluated either on paper or on the forearm. Picture references were developed for the attributes that were evaluated on the paper. Panelists stroked the lip product across this grid to measure opacity. For the forearm, one back-and-forth (forward and backward) stroke of the product across the forearm was used to evaluate most of the appearance and texture attributes. These procedures allowed for a consistent testing technique that was followed during subsequent testing.

Results and Discussion

The final lexicon consisted of four evaluation categories and 16 terms. The evaluation categories were 'Initial Texture', 'Initial Appearance', 'After Texture' and 'After Appearance', as shown in Table 3. The 'initial' attributes were evaluated immediately following application to the forearm; 'after' attributes were evaluated 10 min after application. This time period can change depending on a particular study's objectives. Each attribute consisted of references representing high, medium, and low intensities. For easier duplication of the lexicon and

consistency, pictures were used as references for several attributes, including color intensity (Fig. 1), glittery (Fig. 2), pearl-like (Fig. 3), coverage (Fig. 4), opacity (Fig. 5), and feathering (Fig. 6). These picture references (ADHIKARI-LIP_LEXICON-SUPPL.pdf) can be found on a publicly accessible site on the World Wide Web at: <http://hdl.handle.net/2097/996>. Some of the appearance attributes (e.g. color intensity, glittery, pearl-like) also could be measured in the container, and some attributes like tackiness could be measured in the aftereffects depending on the objectives of the study.

The panelists also developed specific protocols for evaluating each attribute (Table 4). Because skin (both appearance and feel) can be different for different people, certain attributes may yield different results. The panelists found that some attributes could not be effectively evaluated using only the forearm. Smoothness was evaluated by rubbing the thumb and forefinger together to detect any graininess. During orientation, panelists mentioned that the most dramatic difference in attributes was observed within the first five minutes. However, "feathering" could require a longer observation time.

Our lexicon has both similarities and differences to the lexicon developed for skin-care products by Civille and Dus (1991). Both lexicons include similar terms such as wetness, gloss, spreadability, amount of residue and type of residue. Attributes like firmness, stringiness and peaking were not part of our lexicon probably because these terms are more relevant for creams and lotions than for lip products. Definitions and protocol for the similar attributes are different because of the products being tested. They used, mainly, creams and lotions in their study. Our study used a scale that ranged from 0 to 15 with 0.5 increments, while Civille and Dus (1991) used a 10-point scale with verbal anchor points.

EXPERIMENT 3 – USING THE LEXICON

The specific objectives of the third study were to 1) confirm whether the lexicon could be used effectively to discriminate among a new set of samples, and 2) compare whether highly trained panelists with or without experience testing lip products could both effectively use the lexicon to discriminate products.

Materials and Methods

Panelists. Six highly trained panelists from The Sensory Analysis Center at Kansas State University (Manhattan, KS) participated in this study. Three of these panelists had experience evaluating lip products during the lexicon development and other testing, and three new panelists were recruited from a group of highly trained panelists without experience in testing lip products. All panelists had over 120 hours of training and 1,500 hours of descriptive analysis experience.

Sample Preparation and Serving Order. Four new products were selected from three lip categories: balms, glosses, and lipsticks (Table 5). Different brands, packaging, applicators, price points (quality), benefits and claims were utilized to achieve the most representative group. Table 6 provides the details of the samples used. All samples were covered with aluminum foil and labeled with a three-digit random code. When testing, the panelists removed the lip/cap to each product and applied in accordance with the specific attribute protocol. Fragrance-free, alcohol-free Equate® Pop-Ups (Wal-Mart, Bentonville, AR) were used to wipe the forearms/fingers between samples. Panelists followed the specific testing protocol for each attribute developed in experiment 2 (Table 4).

For this experiment, some attributes were measured at multiple points in the evaluation. For example, color intensity was measured both in the original container (before application) and

after application. Also, tackiness was measured immediately after application and after 10 minutes to determine the tackiness of the afterfeel.

The experiment was repeated twice with 12 samples. Each session had six panelists and six products. Therefore, a 6 × 6 William's Latin square design (Williams 1949) was used to randomize the serving order. Each panelist saw a different product compared to the other panelists at each time point. The replication had a new randomization. The data were collected using Compusense® five (v4.6.702 SP3, 2003, Compusense, Inc., Guelph, Ontario, Canada), a computerized data collection system.

Data Analysis. Analysis of Variance (ANOVA) using PROC GLM (General Linear Models procedure) in SAS® (v9.1.3, 2002-2003; SAS Institute, Cary, NC) was carried out on the descriptive analysis data to find differences among the products within a product category and across all the three product categories. Post-hoc mean separation was carried out by using Fisher's least significant difference (LSD). Differences were determined at 5% level of significance. Principal Component Analysis (PCA) was also conducted on the descriptive panel data (Unscrambler®, 2004, version 9.0; Camo A/S, Oslo, Norway) to evaluate the relationships between the sensory attributes and the products, and to determine if products were categorized in their respective categories (lipsticks, glosses and balms). The mean data (averaged across judges and replicates) was used for the PCA.

The panel by product interaction in ANOVA (General Linear Models procedure in SAS®) was studied to compare the performance of the two panels (experienced vs. new). For the attributes where significant panel by product interaction ($P < 0.05$) was found, the mean scores were graphed for the two subpanels by products.

Results and Discussion

The lexicon for the lip products was able to discern differences among and within the three product categories, glosses, lipsticks and balms (Table 6). Some attributes were common for all the three product categories, for only two product categories, or unique to a particular category. For instance, the attribute 'pearl-like' was present at a higher intensities in only two samples (Bonne Bell gloss and Clinique lipstick), and it was almost absent in the balms. Lip balms and lip glosses were similar for smoothness, wet, waxy appearance and opacity. Attributes that were similar for lip gloss and lipsticks were spreadability, initial drag, product to product drag, and pearl-like. Tackiness and coverage were scored similarly for lip balms and lipsticks. As expected, color intensity of the lipsticks were more similar to each other and were different from the glosses and balms.

The Principal Component Analysis (PCA) map (Fig. 7) showed that the lexicon tended to group the lipsticks together, showed some differences and similarities among the glosses, and shows the balms spread over the map. The grouping of the four lipstick samples seemed to be most impacted by appearance characteristics with some textural components (i.e. drag). As expected, the lip glosses were more associated with wet and shine. Lip glosses tend to have lower amounts of wax and higher amounts of oil compared to lipsticks and lip balms. These ingredients give the lip glosses a shiny/wet look (Johnson 1999; Williams and Schmitt 1992). Some of both the lip sticks and the lip glosses produced feathering after 10 minutes of wear. For balms, products differed greatly on many characteristics including shine, tackiness, smoothness, spread, and coverage.

A significant panel by product interaction was seen for 4 (color intensity 1, wet, glittery and opacity) out of 18 attributes. As seen in Fig. 8 (products vs. intensity graphs for the four

attributes), the inexperienced group's (■) general tendency was to give higher intensity rating to these four attributes for some of the products. More orientation time would have reduced the deviation in the scores. Chambers and Smith (1993) showed that panelists with more experience did not perform differently than those with less experience when provided with the same orientation time. Chambers *et al.* (2004) observed that higher levels of training (60-120 h) resulted in finding smaller differences and reduced variation among panelists. This differs from Bitnes *et al.* (2007) who found that sensory experts with experience in a product category (e.g. chocolate) tended to perform slightly better than experts outside the category (e.g. sausage) on products in that category (chocolate). However, the panelists used in Bitnes *et al.* (2007) determined their own training and, the sausage experts spent four times as much time orienting to the sausage products as they did orienting to other products, which clearly could impact their finding that performance is related to experience in a category.

CONCLUSIONS

A lip product lexicon was developed. Descriptive testing using the lexicon was conducted to check that the lexicon could differentiate among products both within and among categories of lip products. Overall, the lexicon worked well in distinguishing between lip glosses, lip balms and lipsticks. The four lipstick samples were grouped more similarly, primarily because of their appearance attributes. Scoring overlap occurred for the glosses and balms possibly because of common ingredients or applicator type. New panelists, who did not participate in the lexicon development, were able to use the lexicon effectively. This study tested a wide range, but limited number of samples in the lip product category. It did not include

specialty products, such as lip plumpers and lip liners, which might provide additional attributes. Future studies can focus on the ‘flavor’ and ‘sensation’ attributes also.

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TABLE 1.
SOME CHARACTERISTICS OF LIP PRODUCTS ELICITED BY FOCUS GROUP PARTICIPANTS; AND SOME POTENTIAL ATTRIBUTES GENERATED BY THE GROUPS FOR THE DESCRIPTIVE PANEL

CHARACTERISTICS OF LIP PRODUCTS

Positive Characteristics		Negative Characteristics	
Color	Flavor	Crusty	Gritty feel
Glossy	Feels comfortable	Waxy residue	Gooey/gummy
Cannot feel it on lips	Slipperiness	Sticky	Dull
Proper thickness	No drag/ easy glide	Too thin, too thick	Color
Long-lasting	Applicator- wand, tube, bullet	Stains lips	Messy
Moisturizing	Aroma	Drying	Feathering
Reasonable price	Smooth	Smell or taste	Cracking
Not gritty	Shimmer	Not true to color	Bleeding

ATTRIBUTES SUGGESTED BY FOCUS GROUPS FOR TRAINED PANEL

Appearance	Texture	After removal
Glossiness	Grittiness	Staining
Shimmer	Waxy	Drying
Amount of Color	Thickness	Moisturizing
Sheerness/Opaqueness	Stickiness	
	Viscosity	

TABLE 2.
SAMPLE DESCRIPTIONS OF LIP PRODUCTS USED IN THE LEXICON DEVELOPMENT

Product Type	Product Description	Applicator
Gloss	Rimmel Sweet Jelly Sheer Lipgloss (Rimmel London, New York, NY)	Squeeze tube
	N.Y.C. (New York Color) Kiss Gloss, Fresh Flavor, Super Shine (Del Laboratories, Uniondale, NY)	Squeeze tube
	Neutrogena MoistureShine Lip Soother, Cooling Hydragel, SPF 20 (Neutrogena Corporation, Los Angeles, CA)	Pot/tub
	L'Oreal Colour Juice; Sheer Juicy Lip Gloss (L'Oreal USA, New York, NY)	Squeeze tube
	Maybelline Shine Seduction Glossy Lipcolor (L'Oreal USA)	Bullet
Lipstick	Maybelline Moisture Extreme with SPF (L'Oreal USA)	Bullet
	Almay Hydracolor Lipstick with SPF 15; refreshing hydration (Almay, Inc., New York, NY)	Bullet
	Cover Girl Incredifull Lip Color (Procter & Gamble, Hunt Valley, MD)	Bullet
	Love My Lips (Bari Cosmetics Ltd., Greenwich, CT)	Bullet
	L'Oreal Colour Riche (L'Oreal USA)	Bullet
Balm	Carmex with EZ-on applicator (Carma Laboratories, Inc., Franklin, WI)	Squeeze tube
	Bonne Belle Lip Smacker (The Bonne Bell Company, Lakewood, OH)	Bullet
	Classic ChapStick (Wyeth Consumer Healthcare, Madison, NJ)	Bullet
	Blistex Medicated Lip Balm with SPF 15 (Blistex, Inc., Oak Brook, IL)	Rolling ball
	Softlips with SPF 20 (The Mentholatum Co., Inc., Orchard Park, NY)	Bullet

TABLE 3.
LIP PRODUCT SENSORY ATTRIBUTES, DEFINITIONS, REFERENCES AND INTENSITIES DEVELOPED BY THE DESCRIPTIVE PANEL USING A 0-15 SCALE WITH 0.5 INCREMENTS

Sensory Attribute	Definition	Reference[a] and Intensity[b]
Initial Texture		
Smoothness	Evenness of the sample; absence of grains, clumps, lumps, etc.	Morton's Iodized Salt = 3.0 Arm & Hammer Baking Soda = 6.0 Johnson & Johnson 24-hour Moisturizer = 15.0
Spreadability	The ease in which the product can be manipulated on the surface of the forearm.	Vaseline® = 5.0 Chapstick (Classic) = 9.0 Johnson & Johnson 24-hour Moisturizer =13.0
Initial Drag	The amount of pressure required for application of product on clean skin.	Johnson & Johnson 24-hour Moisturizer = 1.0 Zinc Oxide = 6.0 Chapstick (Classic) = 12.0
Product to product drag	The amount of pressure required for application of product onto skin with one layer of product already applied.	Johnson & Johnson 24-hour Moisturizer = 1.0 Chapstick (Classic) = 5.0 Zinc Oxide = 12.0
Tackiness	The degree to which fingers adhere to the product; amount of adhesiveness.	Johnson & Johnson Baby Oil = 0.0 Post-it® Note = 7.5
Initial Appearance[c]		
Color Intensity[d]	Intensity of the color of the product on the arm (after application). Fig. 1 can be recreated using Microsoft® Word.	Fig. 1 White (R: 255, G: 255, B: 255) = 0.0 Light Pink (R: 255, G: 163, B: 163) = 3.0 Mid-Pink (R: 255, G: 75, B: 75) = 7.5 Burgundy (R: 176, G: 0, B: 0) = 11.0 Black (R: 0, G: 0, B: 0) = 15.0

Shininess	The amount of gloss or shine perceived on the surface of the product.	Porter Paints #6890-1 Antique White Flat Finish = 0.0 Porter Paints #6890-1 Antique White Eggshell Finish = 2.0 Porter Paints #6890-1 Antique White Satin Finish = 5.0 Porter Paints #6890-1 Antique White Semi-Gloss Finish = 8.0 Porter Paints #6890-1 Antique White Gloss Finish = 12.0
Wet	The appearance of looking wet; opposite of dry.	Vaseline® (untouched) = 5.0 Johnson & Johnson Baby Oil = 14.0
Glittery[d]	Sample composed of individual reflective particles that have a sparkling effect.	Fig. 2A = 2 Fig. 2B = 6 Fig. 2C = 9 Fig. 2D = 14
Pearl-like[d]	A soft, reflective luster reminiscent of a pearl or mother-of-pearl; gives depth.	Fig. 3A = 0 Fig. 3B = 2.5 Fig. 3C = 10 Fig. 3D = 13
Waxy Appearance	The degree to which the product looks like paraffin.	Vaseline® (untouched) = 5.0 Gulf Wax® Household paraffin wax = 12
Coverage[d]	The amount of testing surface covered by the product.	Fig. 4A = 2 Fig. 4B = 5 Fig. 4C = 10 Fig. 4D = 15
Opacity[d]	The degree of opaqueness of the product.	Fig. 5

After Appearance[e]		
Feathering[d]	The movement of product from lips into the surrounding skin lines.	Fig. 6A = 2 Fig. 6B = 4 Fig. 6C = 10 Fig. 6D = 12
After Texture[e]		
Degree of Absorption	Degree of absorption of product into the forearm after a ten minute period.	Pillsbury Creamy Supreme (Strawberry) Frosting = 2.0 Chapstick (Classic) = 8.0 Johnson & Johnson 24-hour Moisturizer = 12.0
Amount of Residue	A measure of the product left on the skin after a ten minute period.	Johnson & Johnson 24-hour Moisturizer = 2.0 Chapstick (Classic) = 8.0 Vaseline®= 12.0

[a]References were prepared approximately 24 hours prior to testing each day.
[b]Intensity ratings are based on a 0-15 scale with 0.5 increments.
[c]Measured after application.
[d]Attributes in **bold** indicate an attribute with picture references.
[e]These effects needs to be measured at times in accordance with the study's objectives and products.

TABLE 4.
DESCRIPTIVE ANALYSIS ATTRIBUTES' ORDER OF EVALUATION AND EVALUATION TECHNIQUES

Order of Evaluation	Evaluation Technique
Initial Texture	
Smoothness	Apply a pea sized amount of product (approximately 1/4″ diameter) to thumb, move forefinger across thumb surface to gauge the degree of smoothness.
Spreadability	Spread a pea sized amount of product (approximately 1/4″ diameter) onto forearm using product applicator. If a pot/tub, use a plastic knife to scoop out designated amount. Apply the product to one spot on skin. Spread back-and-forth ONCE with index finger about two inches.
Initial Drag	Apply ONE stroke of the product in a right to left motion using finger or applicator- drag linear- on clean skin of forearm (evaluate product to skin drag)
Product to Product Drag	Leaving finger or applicator in left position move from left to right across the product already on the skin (evaluate product to product drag).
Tackiness	Tap middle finger on product that has been applied to arm; measure the degree to which the finger adheres to the product.
Initial Appearance (New application)	
Color Intensity Shininess Wet Glittery Pearl-like Waxy Appearance	Apply product with ONE forward and backward stroke to designated spot on forearm. Evaluate these 6 attributes (initial appearance) from only that application. Do not apply again.

Coverage	Apply one back-and-forth stroke of the product to beige/flesh-colored PAPER in designated 2″ × 1 ½ ″ area. Measure the intensity according to the amount (i.e. *proportion)* of area covered by the product (NOT a measure of opacity).
Opacity	Using the application from "coverage", evaluate the opacity.
After Appearance (Needs to be measured at times in accordance with the study's objectives and products)	
Feathering	Observe any feathering.
After Texture (Time should be specified for a given study depending on the objectives)	
Tackiness	See under "Initial Texture."
Degree of Absorption	With blotting paper, blot product on forearm. Determine the amount of product on the paper. The higher the amount of product on paper, the lower the Degree of Absorption intensity.
Amount of Residue	With blotting paper, blot product on forearm. Determine the amount of product left on the skin.

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405 TABLE 5.
406 LIP PRODUCTS USED FOR VALIDATION OF THE LEXICON

Product Type	Product Description	Shortened Names	Applicator	Price Point[a]
Gloss	Colour Juice #220 (L'Oreal USA)	L'Oreal	Squeeze Tube	Mid
	Lip Lites (Bonne Bell Company)	Bonne Bell	Wand	Low
	Lancome's Juicy Gelee (L'Oreal USA)	Lancome	Pot/tub	High
	Max Factor's MAXalicious Glitz #810 (Proctor & Gamble)	Max Factor	Wand	Mid
Lipstick	Hydracolor #555 (Almay, Inc.)	Almay	Bullet	Mid
	Rich Moisture #321 (Rimmel London)	Rimmel	Bullet	Low
	Colour Surge #302 (Clinique Laboratories, New York, NY)	Clinique	Bullet	High
	Renewist Lipcolor #120 (Revlon, Inc., New York, NY)	Revlon	Bullet	Mid
Balm	Lip Nutrition, Moisture Balm (Neutrogena Corporation)	Neutrogena	Pot/tub	Mid
	Softlips Lip protectant/ sunscreen (Mentholatum Co., Inc.)	Softlips	Stick	Low
	Tender Lip Balm #TLB04 (Estée Lauder, Inc., New York, NY)	Estée Lauder	Squeeze Tube	High
	Lip Infusion Sheer Liquid Balm (Blistex, Inc.)	Blistex	Rolling Tip	Low

[a]The price points represent the varying perceived qualities of the samples. Mid-level prices are from $4-$9; low-level prices are less than $4; and high level prices are above $10.

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TABLE 6.

MEAN INTENSITY SCORES (A 0-15 SCALE WITH 0.5 INCREMENTS) FOR THE DESCRIPTIVE ANALYSIS DATA FOR LIP PRODUCTS

	Gloss				Lipstick				Balm			
ATTRIBUTES	**L'Oreal**	**Bonne Bell**	**Lancome**	**Max Factor**	**Almay**	**Rimmel**	**Clinique**	**Revlon**	**Neutrogena**	**Softlips**	**Estée Lauder**	**Blistex**
Smoothness	9.7^{abc}	9.0^{cd}	10.6^{ab}	8.8^{cd}	7.6^{d}	8.5^{cd}	7.6^{a}	7.8^{d}	10.0^{abc}	9.7^{abc}	9.5^{bc}	11.1^{a}
Spreadability	8.1^{bc}	9.3^{b}	7.7^{c}	8.1^{bc}	9.0^{bc}	9.0^{bc}	8.8^{bc}	8.3^{bc}	9.2^{bc}	9.6^{b}	9.0^{bc}	12.4^{a}
Initial Drag	5.5^{ef}	6.0^{cdef}	6.8^{abc}	7.6^{a}	6.7^{abcd}	6.2^{bcde}	6.6^{abcd}	7.0^{ab}	5.8^{def}	5.1^{f}	5.2^{f}	1.9^{g}
Product to Product Drag	5.1^{bc}	5.0^{bc}	6.1^{ab}	7.0^{a}	5.6^{ab}	5.5^{b}	6.1^{ab}	5.9^{ab}	5.1^{bc}	4.1^{c}	4.9^{bc}	1.2^{d}
Tackiness	5.6^{a}	4.8^{b}	5.8^{a}	5.0^{ab}	3.4^{cd}	3.2^{d}	3.5^{cd}	3.5^{cd}	4.0^{c}	1.9^{e}	5.7^{a}	1.0^{f}
Color Intensity 1	1.4^{f}	4.7^{c}	3.5^{d}	7.2^{b}	8.0^{ab}	8.0^{ab}	7.4^{ab}	8.1^{ab}	2.5^{e}	0.0^{g}	8.2^{a}	1.0^{f}
Shininess	12.4^{a}	11.3^{a}	12.5^{a}	11.5^{a}	7.2^{d}	7.0^{c}	9.2^{b}	8.0^{bc}	11.2^{a}	1.1^{d}	12.2^{a}	11.0^{a}
Wet	8.3^{ab}	5.3^{c}	6.9^{bc}	6.1^{c}	1.7^{d}	1.9^{d}	2.2^{d}	1.8^{d}	6.3^{c}	0.4^{d}	10.2^{a}	5.8^{c}
Glittery	0.4^{d}	2.0^{c}	0.3^{d}	3.6^{b}	0.5^{d}	0.3^{d}	4.7^{a}	3.2^{b}	1.5^{c}	0.0^{d}	0.3^{d}	0.1^{d}
Pearl-like	0.2^{f}	8.8^{a}	0.8^{ef}	3.2^{c}	2.3^{cd}	1.4^{de}	7.5^{b}	2.3^{cd}	0.4^{f}	0.0^{f}	0.8^{ef}	0.1^{f}
Waxy Appearance	0.3^{cde}	0.7^{bcd}	0.1^{de}	0.9^{abc}	1.0^{ab}	1.5^{a}	1.1^{ab}	1.1^{ab}	1.4^{a}	0.8^{abc}	0.0^{e}	0.3^{cde}
Coverage	6.7^{e}	8.5^{cde}	8.1^{cde}	7.6^{de}	9.8^{bcd}	10.3^{bc}	11.8^{b}	9.0^{cde}	8.7^{cde}	14.3^{a}	7.2^{de}	8.9^{cde}
Opacity	1.7^{ef}	6.7^{b}	2.5^{def}	3.8^{cd}	7.1^{b}	4.8^{c}	9.6^{a}	7.8^{b}	2.9^{de}	1.2^{ef}	7.7^{b}	1.0^{f}
Color Intensity 2	3.1^{f}	5.9^{e}	7.4^{d}	9.6^{c}	10.2^{bc}	10.2^{bc}	11.2^{a}	10.7^{ab}	5.4^{e}	0.0^{g}	9.2^{c}	0.8^{g}
Feathering	1.4^{a}	1.5^{a}	1.5^{a}	1.9^{a}	1.6^{a}	1.8^{a}	1.0^{ab}	1.6^{a}	1.4^{a}	0.0^{b}	1.9^{a}	1.7^{a}
Tackiness	5.8^{a}	4.0^{b}	5.6^{a}	4.2^{b}	2.4^{c}	2.3^{c}	3.4^{bc}	3.5^{b}	3.2^{bc}	1.1^{d}	5.6^{a}	1.0^{d}
Degree of Absorption	5.5^{bcd}	6.0^{bc}	5.8^{bcd}	4.5^{d}	6.4^{bc}	6.4^{bc}	6.4^{bc}	6.5^{b}	5.7^{bcd}	8.1^{a}	4.9^{cd}	4.5^{d}
Amount of Residue	4.1^{ef}	6.0^{cd}	4.9^{de}	5.9^{cd}	7.7^{ab}	7.8^{ab}	6.2^{c}	7.8^{a}	3.3^{fg}	2.4^{g}	6.5^{bc}	3.4^{fg}

^{a,b,c,d,e,f,g}Row means with the same letter are not significantly different ($P < 0.05$).

FIGURES 1-6 ARE PRESENTED IN A SUPPLEMENTARY DOCUMENT (PORTABLE DOCUMENT FORMAT OR PDF FILE) NAMED 'ADHIKARI-LIP_LEXICON-SUPPL.pdf'. THIS FILE WILL BE AVAILABLE TO READERS ON THE WORLD WIDE WEB AT: <http://hdl.handle.net/2097/996>.

FIG. 1. REFERENCE FOR COLOR INTENSITY (1 AND 2)

FIG. 2. REFERENCE FOR GLITTERY

FIG. 3. REFERENCE FOR PEARL-LIKE

FIG. 4. REFERENCE FOR COVERAGE

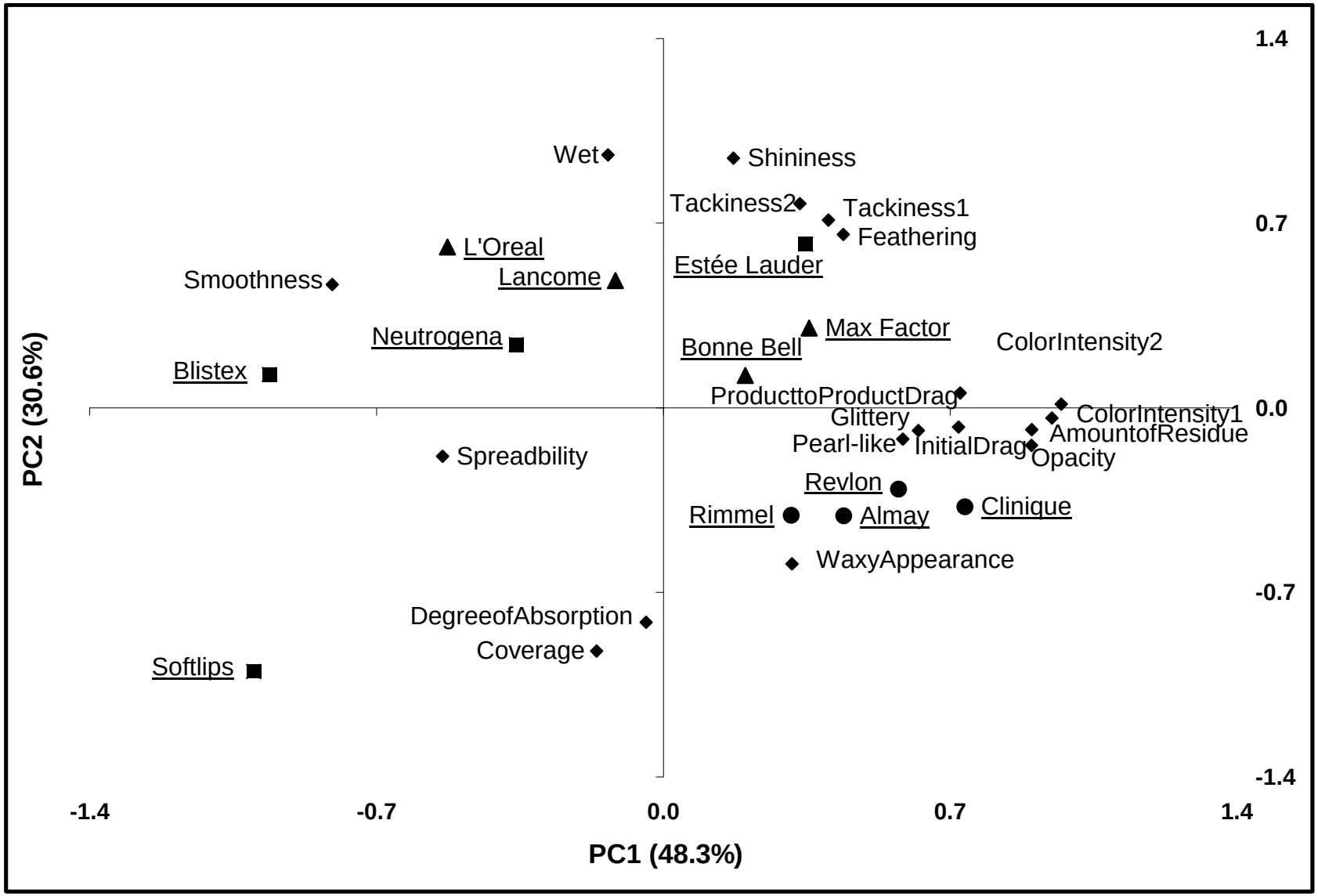
FIG. 5. REFERENCE FOR OPACITY

FIG. 6. REFERENCE FOR FEATHERING

FIG. 7. PRINCIPAL COMPONENTS ANALYSIS MAP SHOWING THE LIP PRODUCTS (▲ – GLOSSES; ● – LIPSTICKS; ■ – BALMS) IN RELATION TO THE ATTRIBUTES (◆)

FIG. 8. GRAPHS FOR ATTRIBUTES (WET, GLITTERY, OPACITY AND COLOR INTENSITY 1) THAT SHOWED SIGNIFICANT PANELIST BY PRODUCT INTERACTION (◆ – EXPERIENCED PANELISTS, AND ■ – NEW PANELISTS)

427 FIG. 7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Tackiness2
Tackiness1
Feathering
L'Oreal
Estée Lauder
Smoothness
Lancome
Max Factor
Neutrogena
Bonne Bell
ColorIntensity2
Blistex
ProducttoProductDrag
Glittery
ColorIntensity1
AmountofResidue
Pearl-like
InitialDrag
Opacity
Spreadbility
Revlon
Rimmel
Almay
Clinique
WaxyAppearance
DegreeofAbsorption
Coverage
Softlips
1.4
0.7
0.0
-0.7
-1.4
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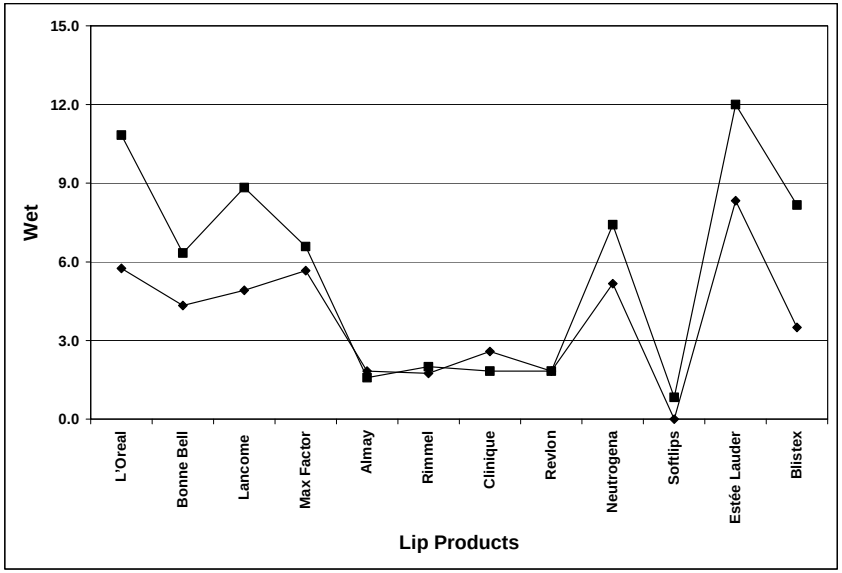
0.7
1.4
PC2 (30.6%)
PC1 (48.3%)

428

Fig. 8.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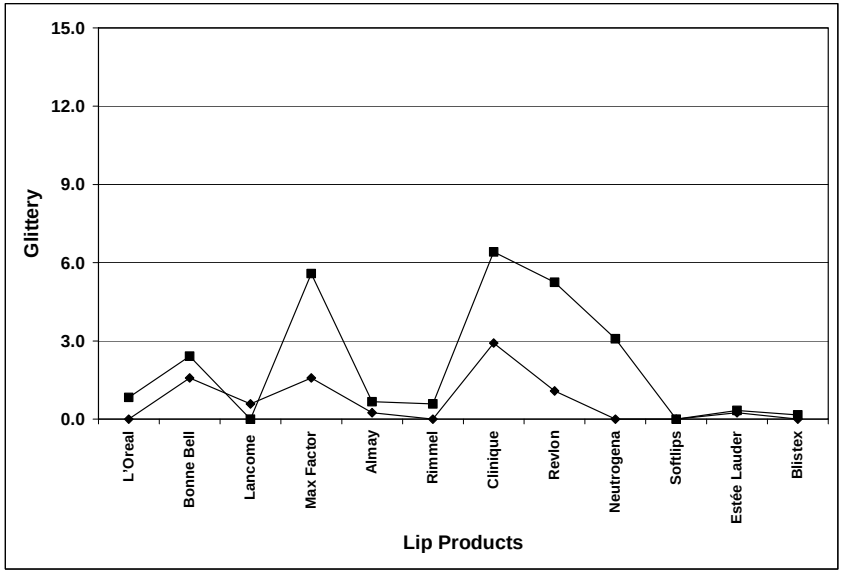
Softlips
Estée Lauder
Blistex
Lip Products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3.0
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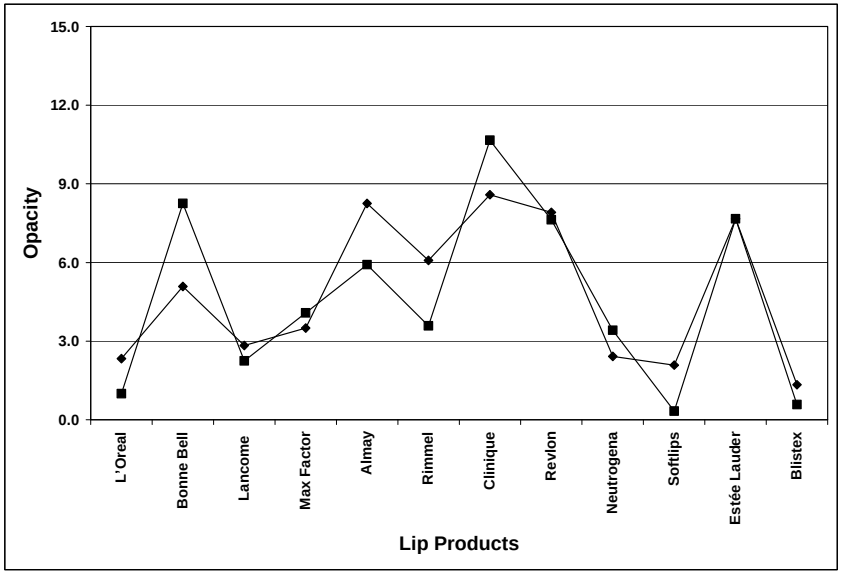
Neutrogena
Softlips
Estée Lauder
Blistex
Lip Products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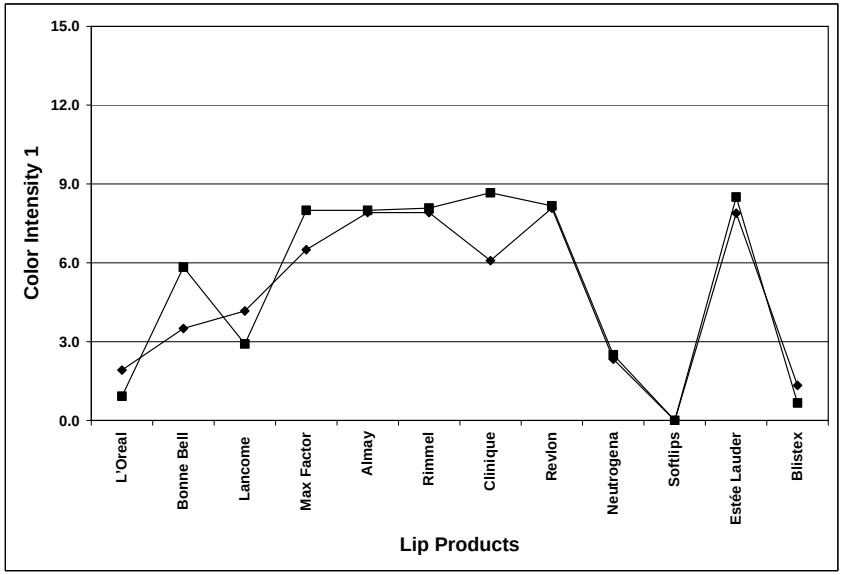
Lip Products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Max Factor
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Clinique
Revlon
Neutrogena
Softlips
Estée Lauder
Blistex
Lip Products