EFFECTS OF CONSUMER CHARACTERISTICS AND PERCEIVED ATTRIBUTES ON PERCEPTION OF FRAGRANCES

by

PANAT CHERDCHU

B.S, Kasetsart University, 2005
M.S., Kasetsart University, 2008

AN ABSTRACT OF DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Human Nutrition
College of Human Ecology

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Abstract

Understanding how consumers perceive fragrances based on different aspects (e.g., hedonic, emotions, term association, expectation of functional benefit, and use occasion, etc.) can help product developers or marketers create the right product or message for consumers. The objective of this study was to understand how consumers from different demographic groups, personality types, and liking patterns responded to fragrance samples. Five masculine odorants were selected and evaluated by 240 consumers across the United States.

Results demonstrated that consumers from different groups (classified based on age, gender, or personality) generally differentiated products similarly. However, consumers from different personality segments used the scales differently. That is, persons who were more open, extrovert, or agreeable tended to score higher than the others.

Consumers associated the most liked odorants with terms such as *clean, crisp, fresh*, and *natural*. In addition, the most liked odorants increased positive emotions, tended to be used across the most occasions, were appropriate for most products, and raised expectations of functional benefits. In contrast, consumers associated the least liked samples with the terms *heavy* and *bold* and had negative responses to most items. Similar findings were found when analyses were conducted on consumers classifying based on liking patterns. Each consumer group liked specific odorants; however, the relationship between the most liked samples and the response variables were similar.

Analysis results demonstrated that openness to experience was the only personality factor that influenced fragrance acceptance. Consumers from different demographic segments tended to like different fragrances. For example, men tended to like *chypré* smells, whereas younger consumers tended to like *soft floral/powdery* scents.

One limitation of the study is the number and type of fragrances tested. It is possible that a different set of fragrances could have produced different results. However, the range of fragrances in this study was broad-based and generally covered the types of fragrances typically available in the marketplace.

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INTRODUCTION

Chapter 1 - Introduction

Scientists understand the selection process as a complex process of how a person decides to select or consume a product. The selection process has been widely investigated and developed within food choice and consumption concepts (Furnham & Heaven 1999; Pettinger, Holdsworth, & Gerber, 2004; Eertmans, Victoir, Vansant, & Bergh, 2005). The selection criteria are categorized into two main categories based on product orientation: (a) an internal stimuli (i.e., a sensory profile of a product) or (b) an external stimuli (e.g., a person's attributes, such as cognitive information and other personal factors) (Shepherd & Sparks, 1994; Eertmans et al., 2005).

Scientists believe that personal factors or individual differences influence a person's sensory perception, preference and acceptance, as well as health belief and concerns (Furst, Connors, Bisogni, Sobal, & Falk, 1996; Pettinger et al., 2004; Rétiveau, 2004; Eertmans et al., 2005). Personal factors consist of demographic characteristics (i.e., age and gender), socio-economic (e.g., income, marital status, and cultural), psychological and physiological disposition (e.g., lifestyle, personality trait, moods, emotions, attitudes, and behavior responses) (Rétiveau, 2004; Eertmans et al., 2005; Honkanen, Olsen, & Myrland, 2006).

Researchers in marketing, sensory science, and psychology primarily use personal factors for classifying consumers into specific populations to aid in understanding consumers (Wedel & Kamakura, 1998; Honkanen et al., 2006; Haugtvedt, Kardes, & Herr, 2008; Kergoat, Giboreau, Nicod, Faye, Diaz, Beetschen, Gerritsen, & Meyer, 2010). Researchers use information obtained from each consumer segment for interpreting and explaining the underlying characteristics, as well as assisting in understanding consumer preference of consumers from a particular segment or comparing differences among consumer segments (Beane & Ennis, 1987; Dickson & Ginter,

1987; Tynan & Drayton, 1987; Wind, 1978; Funk & Phillips, 1990; Gehrt, 1999; Franks, Lubetkin, & Melnikow, 2007; Honkanen et al., 2006; Rentfrow, Goldberg, & Zilca, 2011).

Demographic Characteristics

Demographic characteristics consist of individual demographics (e.g., age, gender, ethnicity, education level, and income), a social class and household information (e.g., number and age of children, marital status, etc.), as well as location and other geographical aspects (Dommeyer & Gross, 2003; Franks, Lubetkin, & Melnikow, 2007; Honkanen et al., 2006; Rentfrow, Goldberg, & Zilca, 2011; Pescud, Pettigrew, Donovan, Cowie, & Fielder, 2012).

According to Honkanen et al. (2006), demographic segmentation emerges as the most prevalent criteria for consumer segmentation, which is suitable for a specific product category/market study. Results obtained from demographic segmentation are easy to understand and interpret (FitzGerald & Arnott, 1996). In fragrance research, for example, it has found that age and gender highly influenced motivations in fragrance use and preference (Bain, 1997; Graham, 2000; Rétiveau, 2004).

As an age increasing, a person tends to wear a fragrance due to emotion and attraction benefits. Men are more likely to use fragrances for romance and social motives. On the other hand, women use fragrances for inner-directed and emotional motives (Rétiveau, 2004). Research demonstrated that men and younger population (both male and female) tend to use one fragrance across many situations. In contrast, women tend to have many fragrances to wear for different situations (Aarts, 2003; Rétiveau, 2004). In addition, research documents heavily how women indicate higher interest in scents than men (Herz & Cahill, 1997; Herz & Inzlicht, 2002; Herz, 2004).

A certain type of smell is made for a specific demographic group. The research has showed that the *sweet* and *fruity* smells are well liked by children, whereas *floral, powdery, oriental*, and *sweet* smells are well accepted and primarily made specifically for women (Rétiveau, 2004; Donna, 2009; Zarzo, 2007). On the other hand, the *fresh* scents (*citrus, water/marine, green,* and *fruity*) and *dry-woody* scents (*woods, dry woods, mossy,* and *aromatic/fougère*) were generally liked and made specifically for men (Rétiveau, 2004; Gilbert, 2008; Donna, 2009; Zarzo, 2007).

The use of demographic segmentation tends to perform well on differentiating consumers bases on product category. However, the demographic segmentation seems to provide insufficient explanation for purchase behavior study (Honkanen et al., 2006). Researchers recommended incorporating the information of psychological and physiological disposition (e.g., personality, preference, attitudes, etc.) in the model to obtain a better explanation, (Kahle & Chiagouris, 1996; McCarty & Shrum, 1993; Riquier, Kennedy, & Sharp, 1998; Honkanen et al., 2006).

Personality Characteristics

Personality is a set of characteristics of an individual. It is believed to be a foundation of individual difference because it influences a person's pattern of thought, emotions, motivations, and behaviors. Personality traits tend to be stable over time where emotions, are more transient (Revelle & Scherer, 2009). For decades, researchers in psychology have conducted studies on personality (Goldberg, 1990) and developed several trait theories explaining and classifying personality structure. One personality trait theory describes personality traits in a five-dimension personality framework known as the "Big-Five" of human personality (Goldberg, 1990). The five-dimensions include: extraversion (sociable, assertive, talkative), neuroticism (anxious,

irritable, emotional), agreeableness (sympathetic, kind, understanding), conscientiousness (organized, reliable), and openness to experience (creative, imaginative, innovative) (Goldberg, 1990; McCrae & Costa, 1999).

Researchers developed numerous self-report questionnaires and currently use them for research on personality. The questionnaires consist of 18 to 200 trait adjectives or statements relating to the five-dimensions of personality (Costa & McCrae, 1992; McCrae & Costa, 1999; Salgado, 2003). The collected responses were averaged within each personality category and presented as five-comprehensive dimensions (Benet-Martínez & John, 1998; McCrae & Costa, 1999). Researchers studying the understanding of relationships between personality and other personal variables, e.g., behavior (O'Malley & Gillette, 1984) and mood (Harris & Lucia, 2003), widely use self-report questionnaires as part of their research.

The use of personality characteristics segmentation for purchase behavior or preference study seems to provide well understanding explanation. Fragrance studies demonstrated that extraversion and agreeableness tends to be related to fragrance acceptance (Rétiveau, 2004) and influences on how women decide to wear a particular fragrance (Aarts, 2003). Moreover, the studies conducted by Mensing & Beck (1988) and Rétiveau (2004) demonstrated that people who have similar personality type tend to like similar perfumes. For example, people who are more agreeable tend to like fragrance characterized by *fruity* notes. Furthermore, extrovert persons tend to like *fougère* perfumes or odorants characterized as, *energizing, fresh*, and *noticeable*, whereas, introvert persons tend to like *warm, comfort,* and *oriental* scents. Similarly, emotionally stable persons tend to like perfumes characterized as *floral* and *chypré,* whereas neurotic persons (emotionally unstable) tend to like perfumes characterized as *floral-powdery* (Mensing & Beck, 1988; Rétiveau, 2004).

Consumer Acceptability and Preference

Acceptability and Preference are core evaluative constructs for predicting food choice and behavior (MacFie & Thomson, 1994). Preference pattern of an individual toward alternative products is found to be heterogeneous (Honkanen et al., 2006). Thus, segmentation using consumer preference is thought to be important and appropriate for managerial implementation (Kardes, 1999; Honkanen et al., 2006). Often times, segmentation using preference or 'liking' results in distinct clusters of preference patterns (Kergoat et al., 2010).

Research Outline

A better understanding of how consumers perceive fragrances in different aspects (i.e., hedonic, emotion, use occasion, association between terms and odorants, potential application of fragrance in personal care products, and expectation of functional benefits) would aid product developer creating right product that satisfies consumers. Therefore the objective of this study aimed to understand consumer responses toward fragrance samples. Consumers who participated in this study were male consumers who used cologne, fragrance, or fragranced personal care products and female consumers who liked the scents of cologne, fragrance, or personal care products on men.

Throughout the study, only men cologne samples were used to reduce the variability of the gender association category of fragrance. Women and unisex fragrances were excluded from the study. The study was conducted nationwide using an internet survey. Participants received a package consisted of cologne samples and evaluated each sample as instructed.

The dissertation consisted of 7 studies. The first study (chapter 4) discusses consumer classification and selection based on similarity of the Big-Five personality pattern for the

subsequent studies. Several statistical approaches for classifying consumer's personality were applied and discussed in this process.

Because scent preference varies across individuals (Toller & Dodd, 1991), consumers were classified based on similarity/dissimilarity of demographic information (age and gender) and Big-Five personality. Then, the analyses were conducted to investigate if age, gender (Chapter 5) or difference in big-five personality (Chapter 6) influenced consumer responses.

Because age, gender, and personality had little influence on response scores on a univariate basis, multivariate analyses were conducted on all consumers to investigate differences of men's cologne samples on consumer responses (Chapter 7).

To try and understand consumer responses better, consumers were classified into groups based on similarity of their liking scores across odor samples. Same analyses were used to investigate if liking affected their responses (Chapter 8).

Because consumer acceptance contributed substantially to variation on consumer responses, sensory profiles of men's fragrances generated by a fragrance expert were used to determine if consumers who had different liking pattern perceived or associated sensory-related terms with odorants (Chapter 9).

The final chapter (chapter 10) explains effectiveness of segmentation criteria for understanding consumer acceptance and indicating fragrance trends for specific consumer segments.

References

Aarts, P. (2003). Fragrances with real impact. *Perfumer and Flavorist*, *28*(5), 34-49.

Bain, H. (1997). Why people use perfumes. In P. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp. 232-239). London: Blackie Academic and Professional, Chapman and Hall.

Beane, T. P., & Ennis, D. M. (1987). Market segmentation: A review. *European Journal of Marketing*, *21*(5), 20–42.

Benet-Martínez, V., & John, O.P. (1998). Los cinco grandes across cultures and ethnic groups: Multitrait method analyses of the Big Five in Spanish and English. *Journal of Personality and Social Psychology, 75*, 729-750.

Costa, P.T., & McCrae, R.R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) Professional Manual*. Florida: Psychological Assessment Resources.

Dickson, P., & Ginter, J. L. (1987). Market segmentation, product differentiation, and marketing strategy. *Journal of Marketing*, *51,* 1–10.

Dommeyer, C. J., & Gross, B. L. (2003). What consumers know and what they do: An investigation of consumer knowledge, awareness, and use of privacy protection strategies. *Journal of Interactive Marketing, 17,* 34–51. doi: 10.1002/dir.10053

Donna, L. (2009, December). Fragrance perception is everything relative? *Perfumer and Flavorist*. *34,* 26-35.

Eertmans, A., Victoir, A., Vansant, G., & Bergh, O. V. D. (2005). Food-related personality trait, food choice motives and food intake: Mediator and moderator relationship. *Food Quality and Preference*, *16*(8), 714-726.

FitzGerald, M., & Arnott, D. (1996). Understanding demographic effects on marketing communications as services. *International Journal of Service Industry Management*, *7*(3), 31–42.

Franks, P., Lubetkin, E. I., & Melnikow, J. (2007). Do personal and societal preferences differ by socio-demographic group? *Health Economics*, *16,* 319–325. doi: 10.1002/hec.1152

Funk, T. F., & Phillips, W. (1990). Segmentation of the market for table eggs in Ontario. *Agribusiness*, *6*(4), 309–327.

Furnham, A., & Heaven, P. (1999). Personality and consumption. In A. Furnham & P. Heaven (Eds.), *Personality and Social Behavior* (pp. 247-279). London: Arnold.

Furst, T., Connors, M., Bisogni, C. A., Sobal, J., & Falk, L. W. (1996). Food choice: A conceptual model of the process. *Appetite*, *26*(3), 247-265.

Gehrt, K. C. (1999). Situational segmentation opportunities in the snack food market. *Journal of Food Products Marketing*, *5*(4), 1–18.

Gilbert, A. N. (2008). *What The Nose Knows: The Science of Scent in Everyday Life.* New York: Harper Perennial.

Goldberg, L.R. (1990). An alternative "description of personality": The Big-Five factor structure. *Journal of Personality and Social Psychology*, 59, 1216-1229.

Graham, J. A. (2000). The psychology of fragrance and aromatherapy. In H. Butler (Ed.), *Poucher's Perfumes, Cosmetics and Soaps* (10th Ed.) (pp. 749-767). Boston: Kluwer Academic.

Harris, J.A., & Lucia, A. (2003). The relationship between self-report mood and personality. *Personality and Individual Differences*, 35, 1903-1909.

Haugtvedt, C. P., Kardes, F. R., & Herr, P. M. (2008). *Handbook of Consumer Psychology*. New York, NY: Psychology Press.

Honkanen, P., Olsen, S. O., & Myrland, Ø. (2006). Preference-based segmentation: A study of meal preferences among Norwegian teenagers. *Journal of Consumer Behaviour*, *3,* 235–250. doi: 10.1002/cb.137

Kahle, L., & Chiagouris, C. (1996). *Values, Lifestyles, and Psychographics*. Hillsdale, NJ: Erlbaum.

Kardes, F. R. (1999). *Consumer Behaviour: Managerial Decision Making*. Reading, MA: Addison-Wesley.

Kergoat, M., Giboreau, A., Nicod, H., Faye, P., Diaz, E., Beetschen, M. A., Gerritsen, N., & Meyer, T. (2010). Psychographic measures and sensory consumer tests: When emotional experience and feeling-based judgments account for preferences. *Food Quality and Preference, 21,* 178–187.

MacFie, H. J. H., & Thomson, D. M. H. (1994). *Measurement of Food Preferences*. Glasgow, Scotland: Blackie Academic & Professional.

McCarty, J. A., & Shrum, L. J. (1993). The role of personal values and demographics in predicting television viewing behavior— Implications for theory and application. *Journal of Advertising*, *22*(4), 77–101.

McCrae, R.R., & Costa, P.T., JR (1999). A Five-factor theory of personality. In L.A. Pervin & O.P. John (Eds.), *Handbook of Personality: Theory and Research* (2nd ed) (pp. 139-153). New York: Guilford press.

Mensing, J., & Beck, C. (1988). The psychology of fragrance selection. In Van Toller, S., & Dodd, G. H. (Eds.), Perfumery: *The Psychology and Biology of Fragrance* (pp. 185-204). London, Chapman & Hall.

O'Malley, M.N., & Gillette, C.S. (1984). Exploring the relations between traits and emotions. *Journal of Personality, 52*(3), 274–284.

Pescud, M., Pettigrew, S., Donovan, R. J., Cowie, S., & Fielder, L. (2012). Australian children's food and drink preferences: Implications for health professionals. *Nutrition & Dietetics*, *69,* 278–284. doi: 10.1111/j.1747-0080.2012.01606.x

Pettinger, C., Holdsworth, M., & Gerber, M. (2004). Psycho-social influences on food choice in southern France and central England. *Appetite*. *42*(3), 307-316.

Rentfrow, P. J., Goldberg, L. R., & Zilca, R. (2011). Listening, watching, and reading: The structure and correlates of entertainment preferences. *Journal of Personality*, *79,* 223–258. doi: 10.1111/j.1467-6494.2010.00662.x

Rétiveau, A. N. (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRetiveau2004.pdf?sequence=1

Revelle, W., & Scherer, K.R. (2009). Personality and emotion. In D. Sander, & K. R. Scherer (Eds.), *Oxford Companion to Emotion and the Affective Sciences* (pp. 21–28). Oxford, United Kingdom: Oxford University Press.

Riquier, C., Kennedy, R., & Sharp, B. (1998). Behaviours versus demographics as identifiers of chad splits: Implementation for segment formation. *Journal of Segmentation in Marketing*, *2*(1), 111–129.

Salgado, J.F. (2003). Predicting job performance using FFM and non-FFM personality measures. *Journal of Occupational and Organizational Psychology, 76*, 323-346.

Shepherd, R., & Sparks, P. (1994). Modeling food choice. In H. J. H. MacFie & D. M. H. Thomson (Eds.), *Measurement of Food Preferences* (pp. 202-225). Glasgow: Chapman and Hall.

Tynan, A. C., & Drayton, J. (1987). Market segmentation. *Journal of Marketing Management*, *2*(3), 301–335.

Wedel, M., & Kamakura, W. A. (1998). *Market Segmentation: Conceptual and Methodological Foundations*. London, UK: Kluwer Academic Publishers.

Wind, Y. (1978). Issues and advances in segmentation Research. *Journal of Marketing Research*, *15,* 317–337

Zarzo, M. (2007). The sense of smell: Molecular basis of odorant recognition. *Biological Reviews*, *82,* 455–479.

LITERATURE REVIEW

Chapter 2 - Literature Review

The sense of smell influences human's social interaction and awareness of others (Stockhorst & Pietrowsky, 2004; Aglioti & Pazzaglia, 2011). People use fragrance and personal care products to represent their status (Grubow & Kastner, 2011) and improve quality of live, as well as express their personality (Api & Hakkinen, 2005; Salvador-Carreño & Chisvert, 2005). Personal appearance and grooming have become more important among consumers leading to the growth of the fragrance and personal care markets. The personal care market, primarily accounted for by skin-care products, globally reached about $96.5 billion in 2011 (Tyrimou, 2012) and the fragrance market is predicted to reach more than $36 billion by 2017 (Anonymous, 2012).

People no longer expect personal care products to deliver just primary properties (i.e., enhancing or masking body odor, cleansing property, moisturization, etc.) (Roberts, Little, Lyndon, Roberts, Havlicek, & Wright, 2009). They also expect products to provide other benefits such as mood enhancement, enjoyable experience, and confidence (John, Christensen, & Boyden, 2006; Roberts et al., 2009).

Personal care products can be categorized into two groups based on functionality types either providing basic functionality (e.g., soap and shampoo for cleansing body and hair, respectively) or enhancing the consumption experience (e.g., aromatherapy and mood enhancement) (Gleason-Allured, 2008; Falk & Penning, 2012).

Fragrance in Personal Care Products

Scientists believe the sense of smell is the most powerful emotional sense in the human (Penning, 2011; Falk & Penning, 2012). Perception of smell surpasses all other four senses due to the direct connection to the limbic system which is responsible for emotions (John et al., 2006;

LeDoux, 2007). Thus, the sense of smell also can be considered more subjective than the senses of touch, sight, and hearing which generally pass through the cortex and potentially receive more processing which can make them more objective (John et al., 2006; Herz & Cupchik, 1995; Herz 1997; Kant, 2006; Aspria, 2009). Scent has an ability to directly establish hedonic response and mood, as well as, elicit memories (Goel & Grasso, 2004; John et al., 2006; Falk, 2007; Willander & Larsson, 2007; Walker, 2009; Penning, 2011; Ruffolo, 2011) or evoke autobiographical memories (Chu & Downes, 2000). Additionally, scent also influences and modulates mood (Schiffman, Sattely-Miller, Suggs, & Graham, 1995; Goel & Grasso 2004; Rétiveau, Chambers IV, & Milliken, 2004), behaviors (Millot & Brand, 2001), cognitions (Hermans, Baeyens, & Eelen, 1998; Heuberger, Hongratanaworakit, Bohm, Weber, & Buchbauer, 2001; Herz, 2004), affective states in humans (Weber & Heuberger, 2008), and performance (Baron & Kalsher, 1998; Robin, Alaoui-Ismaili, Dittmar, & Vernet-Maury 1999; Raudenbush, Meyer, & Epich, 2000). Therefore, the use of fragrance is believed to elevate mood, amplify impression, fulfill immersive experiences and enhance well-being in consumers. (Ruffolo, 2011; Falk & Penning, 2012).

Personal care manufacturers used fragrance to mask unpleasant odors caused by product formulation. However, manufacturers now use fragrance as reinforcement and support for marketing elements (brand, product, packaging, advertising message, etc.) as a whole sensorial package (Schroiff, 1991; Tanner, 2008; Dowthwaite, 2010; Gleason-Allured & Grabenhofer, 2010; Penning, 2011; Falk & Penning, 2012; Porcherot, Delplanque, Planchais, Gaudreau, Accolla, & Cayeux, 2012)

A fragrance is a key element in personal care products as it influences consumer acceptance and purchase intent (Schroiff, 1991; Milotic, 2003; Gleason-Allured, 2008; Tanner,

2008; Gleason-Allured & Grabenhofer, 2010; Grubow & Kastner, 2011). Manufacturers incorporate fragrance in various types of products: body care (e.g., soaps and shower gels), skin care (e.g., body lotions and creams), cosmetics, household care (e.g., dishwashing liquid and laundry products), as well as air-care and luxury items (Wolfe & Busch, 1991; Milotic, 2003). In addition, merchandisers also use fragrance for representing services (e.g., spa, hotels, retailers, and professional salon) (Anonymous, 2007; Gleason-Allured, 2008; Tanner, 2008).

Product developers use scents to differentiate their product from competitors' products (Falk & Penning, 2012). In addition, scents also are used to support other sensory information in order to provide an overall experience (Aglioti & Pazzaglia, 2011). For example, consumers explore new products in the market by glancing to brand or a package that is visually attractive to them, then they may smell the product to decide whether they would like to purchase or continue searching for the right product (Tanner, 2008; Penning, 2011; Harper & Burns, 2012). A consumer's initial purchase decision for personal care products is primarily impacted by fragrance appreciation and expectation for product efficacy or intended functions (Schroiff, 1991; Gleason-Allured, 2008; Hayden, 2008; Gleason-Allured & Grabenhofer, 2010; Grubow & Kastner, 2011; Falk & Penning, 2012).

Scientists have thought that desire and need for emotional connection, sensorial experience, and pleasure influence a person's odorant appreciation (Gleason-Allured, 2008). A product that contains a 'good' fragrance tends to be purchased which may lead to repeat usage and brand loyalty (Gleason-Allured & Grabenhofer, 2010; Penning, 2011; Falk & Penning, 2012). Additionally, fragrances also are used as an ambient scent to influence consumer buying behavior and enhance store atmosphere (Knasko, 1992; Spangenberg, Sprott, Grohmann, & Tracy, 1996; Fiore et al., 2000; Chebat & Michon, 2003). For example, Hollister and

Abercrombie & Fitch merchandises use their own unique fragrances as an ambient scent in the store to enhance shopping experience and strengthen brand awareness. Similarly, a fragrance called "*Meadow Grass*" is distributed in the British Airways' business lounges to create a comfortable feeling for consumers (Ellison & White 2000; Krishna, 2012).

A fragrance can be used in multiple product categories within the same product brand; however, a modified version of a fragrance or different fragrance concentration may fit better to a specific product category concept (Gleason-Allured & Grabenhofer, 2010), different functional benefit (Falk & Penning, 2012), or consumers usage habits (Gleason-Allured & Grabenhofer, 2010). For example, the signature scents of Dove is leveraged across multiple product categories including body wash, deodorant, hair care, and body spray (Falk & Penning, 2012). Their consumers can still perceive the same emotional connection to the brand although the smell of each item is slightly different from one another.

Odor Characterization

Human can detect 5,000-10,000 of distinct odors (Zarzo, 2007; Gilbert, 2008); however, the ability to identify or translate the smell impression into words is more difficult than translating impressions of sight and hearing (Guerer, 2002), especially from the consumer perspective (Gleason-Allured & Grabenhofer, 2010). Odor descriptions are influenced by personal biases of experience, culture, biology, gender, subjectivity and social constructs (Richardson & Zucco, 1989; Herz, Beland, & Hellerstein, 2004; Donna, 2009; Zarzo, 2007; Gilbert, 2008; Zarzo & Stanton, 2009).

Development of odor terms or descriptors is vital for sensory scientists because it provides a standard communication among the research team (Donna, 2009; Zarzo & Stanton, 2009) and clarifies consumer preference (Nute, Macfie, & Greenhoff, 1988). In addition,

descriptor development would aid in a better communication among researchers, retailers and consumers (Jellinek, 1992; Zarzo & Stanton, 2009; Donna, 2009).

An understanding of olfactory elements, as well as how people define and characterize the smell are challenging because terms or descriptions can be specific names (e.g., *lavender, orange, musk*, etc.), subjective sensory associations (e.g., *heavy, crisp, soft, cool, natural,* etc.), or description of odor effects (e.g., *modern, sexy, indulgent,* and *fresh*) (Jellinek, 1992; Gleason-Allured, 2008; Zarzo & Stanton; 2009; Gleason-Allured, 2010; Falk & Penning, 2012). These types of terms are commonly used in advertisements or even journal articles (Gleason-Allured, 2008; Gleason-Allured, 2010; Falk & Penning, 2012).

Rétiveau (2004) developed a set of specific odor names, consisted of nine consumer-friendly adjective terms which were sufficient to describe fragrance characteristics. The nine terms were *citrusy, cool-minty, floral, fruity, green, herbal, spicy, sweet* and *woody*. The adjective terms were found to be efficient for differentiating fragrances based on their sensory properties among a small set of fragrance products. In contrast, the associations and description of odor effects are subjective, ambiguous, and more difficult to interpret compared to the adjective terms.

Therefore, a study of how subjective terms are related to well-defined terms (e.g., descriptive lexicon) would be able to aid a product developer in selecting the most satisfying odorants and using appropriate terms to communicate to consumers.

Edwards (2008) developed a classification system named fragrance wheel which has been used as commercial fragrance reference. The system was created by simplifying and providing relationships among fragrance family based on the similarity of the smell (Donna,

2009). Edwards identified four major family notes (i.e., *fresh, floral, oriental,* and *woody*) and subcategorized each family notes into specific characters (Figure. 2.1)

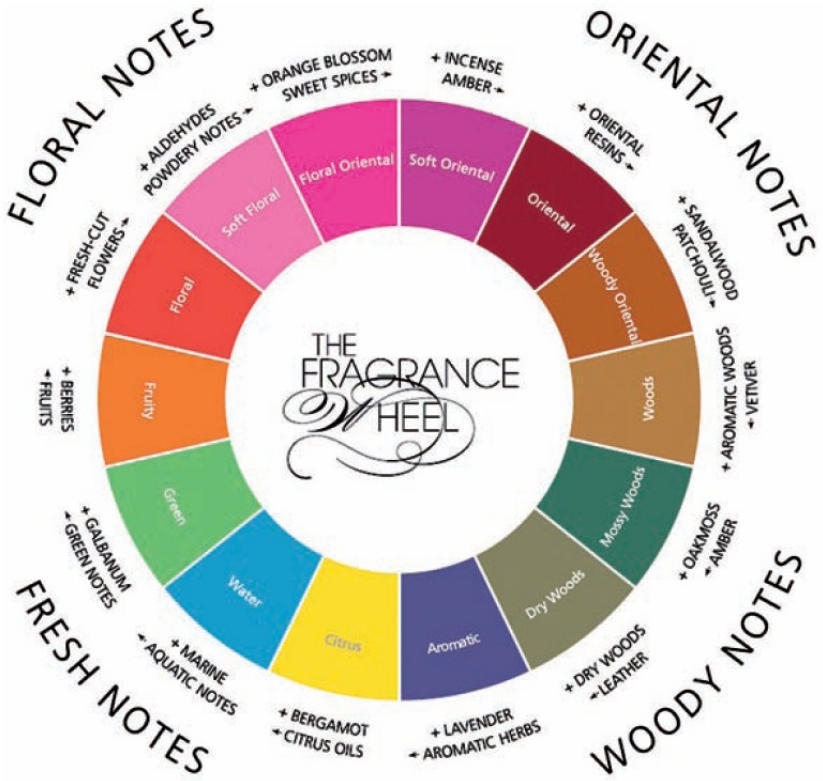


Figure 2.1 **The Fragrance Wheel Developed by Edwards (2008)**
(Source: Donna, 2009)

Functional Benefits of Scents

People generally comprehend that scents can provide benefits such as aromatherapy which originally used plant-based essential oils for therapeutic purposes (John et al., 2006). Aromatherapy evolved into aroma-chology, which generally is related to an application of scents from essential oils and fragrances to provide temporary psychological (mood) benefits or alter moods (e.g., calmness and alertness) (Warrenburg, 2005; John et al., 2006; Weber & Heuberger, 2008) (Note: in consumer vocabulary this often is still called aromatherapy). The use of aroma-therapeutic ingredients has become prevalent in personal care products (Anonymous, 2007).

Manufacturers make products based on the concept of the mind-body connection for healthy minds and bodies of consumers (John et al., 2006).

Certain odors provide different emotional responses. For example, unpleasant odors generally elicit moods such as *irritation*, *apathy*, *stressed*, and *depression*; whereas, pleasant odors evoke *happy*, *relaxing*, *stimulating*, and *sensuality* (Warrenburg, 2005; John et al., 2006).

Jellinek (1951) proposed the odor effect diagram representing the relationships of odors and their physiological and psychological effects on two dimensions. Each dimension represents an emotional state, *refreshing* (erogenous and anti-erogenous) and *stimulating* (narcotic and stimulating), respectively. The odor descriptors that were close together had similar odor effects (listed in *italics* within a square shape) while the distance between each term represents a contrast of odor effects. The diagram also illustrated sensory perceptions of the odors (i.e., bitter, sweet, acid, or alkaline [listed in **bold**]) as well as the source of odor descriptors (listed in **bold** outside the circle shape) either they are from vegetable or animal (Figure 2.2).

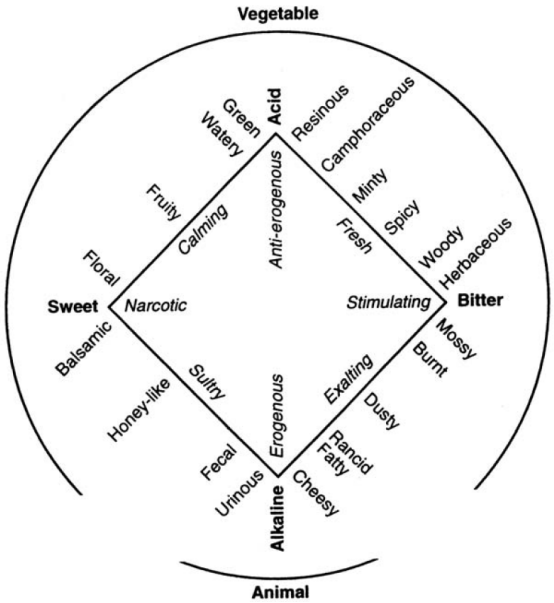


Figure 2.2 **Odor Effects Diagram**
(Source: Jallinek, 1997; Donna, 2009)

The odor effects diagram was validated by Zarzo & Stanton (2009) using Principal Component Analysis (PCA) to illustrate a sensory space of 309 compounds assessed by perfumer experts from Boelen and Harring's study (Boelen & Harring, 1981). Results demonstrated a consistency between the odor effects diagram and odor mapping derived from PCA. The triangles in Figure 2.3 represent odor descriptors from Boelen and Harring (1981) while odor descriptors in *italics* next to white circles represent the original descriptors from Jallinek (1951). Descriptors within parentheses correspond to the simplified diagram proposed by Calkin and Jellinek (1994) (Calkin & Jellinek, 1994; Jellinek, 1997; Zarzo & Stanton, 2009; Donna, 2009).

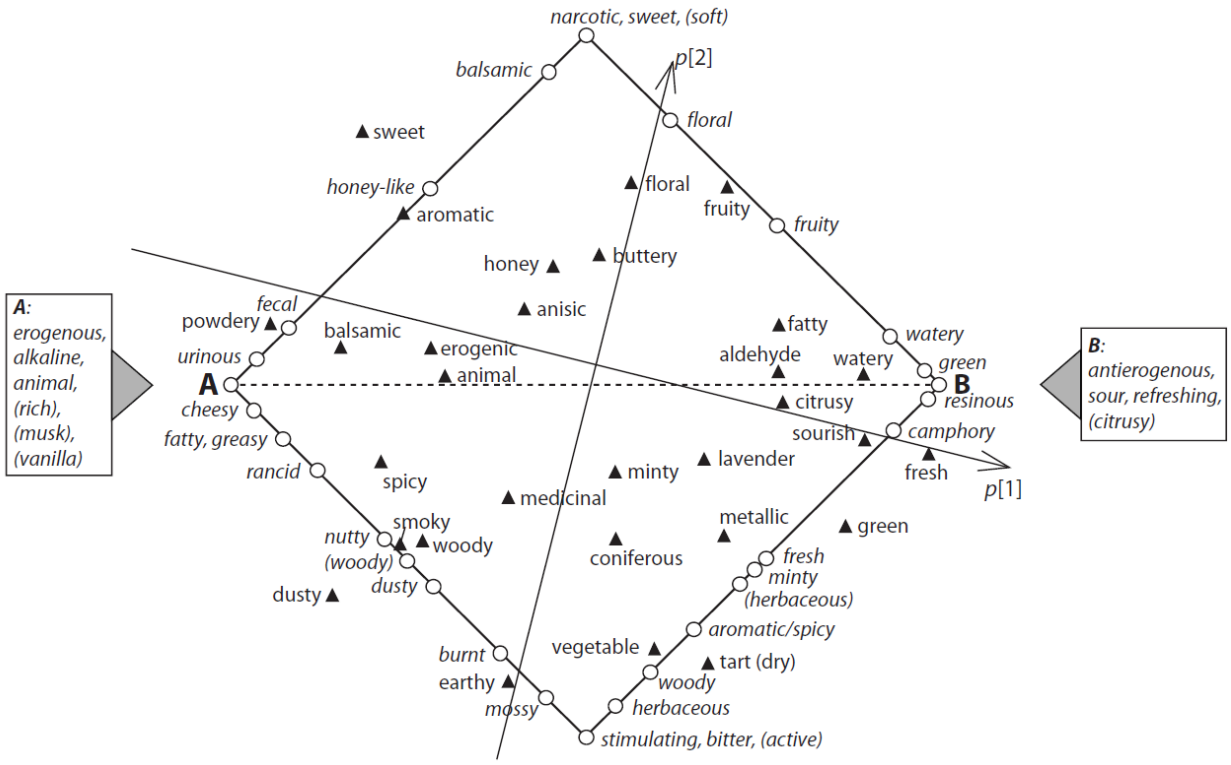


Figure 2.3 **An Overlay of the Two-Dimensional Sensory Map of Odor Descriptors (the dashed lines represent axes from PCA)**

(Source: Zarzo & Stanton, 2009)

It should be noted in both of these studies that the authors proposed a simple 2-dimensional plot for effects that may have many more dimensions. Thus, although the 2-dimensional solution may look similar, much may be lost in only examining 2 overall dimensions (Yenket et al., 2011)

Understanding fragrance composition and function of each odor would greatly aid product developers create a complex fragrance blend to enhance product efficiency and emotional connection for consumer consumption experience (Gregory, 2012). Considerable literature has demonstrated functional properties of scents or influence of scent on human perception. For example, *citrus* scents evoke *fresh* and *clean* feelings, *green* odors evoke *invigorating* and *soothing* feelings*,* spices odors evoke *feeling*, and *woody* notes evoke *soothing* and *relaxing*. In addition, floral notes evoke *luxurious*, *glamorous*, and *beautiful* (Hayden, 2007) (Table 2.1).

Expectation of Emotion and Functional Benefits from Olfactory Cues

Fragrance is used as a message to communicate emotional benefits or functional benefits to consumers (Jellinek, 1997). Therefore, scent should have olfactory cues or signals to reinforce, complement, or initiate consumer expectation to product promise or benefit (Deliza & MacFie, 1996; Gleason-Allured, 2008; Ruffolo, 2011; Falk & Penning, 2012; Gregory, 2012). For example, if a product is claimed to offer a '*soothing experience'*, then the scent should instantly convey or raise consumer expectation of *relaxing* or *calming* feelings to make consumers believe that the product does really work (John et al., 2006; Herman, 2012). Once the expectation reaches parity to perceived benefits, consumer are satisfied that particular product leading to product repurchase and loyalty (Deliza & MacFie, 1996).

Table 2.1 Scents and Their Functional Benefits

Effect*	Citrus	Fruity	Floral	Soft floral	Sweet	Green	Watery	Gourmand	Botanical Herbal	Woody	Spices	Musk
Freshness	x	x	x									
Stimulating	x	x	x						x			
Energizing	x	x	x									
Brighten a mood	x	x	x		x							
Refreshing	x					x						
Energizing												
Invigorating	x					x	x					
Moisture							x	x				
Hydration							x	x				
Luminous			x									
Refined			x									
Luxurious			x									
Relaxing				x					x	x		
Soothing						x			x	x		
Calming									x	x		
Warmth											x	
Natural									x			
Cleansing	x											
Nourishment								x				
Indulgent								x				
Sensual			x									x

* Information obtained and modified from John et al., (2006), Hayden (2007), Gleason-Allured (2008), Towle (2008), Anonymous (2007), Anonymous (2008), Herz (2009), Falk & Penning (2012), and Gregory (2012)

Use Occasion

Aarts (2003) and Rétiveau (2004) reported that certain fragrances either can or cannot cover a range of end use. The choice of scent for end a particular use is influenced by the motive to enhance self-satisfaction, self-efficacy, express personality (inner-directed motives) and be accepted in social setting (social motives) (Snyder, 1990; Snyder & Attridge, 1995; Rétiveau, 2004). This rationale explains findings by Aarts (2003) and Rétiveau (2004) that female consumers have more than one fragrance for different schedules and activities.

Fragrance may vary by use occasion occurs because a person chooses a certain fragrance to wear considering the kinds of information they want to send to others while at the same time pleasing oneself (attraction motives) (Bain, 1997; Graham, 1993; Rétiveau, 2004). The more occasions the fragrance is suitable for, the faster it is likely to be consumed and replaced than fragrances that are suitable for only certain occasions. In the world of masculine personal care products, fragrances that are appropriate for multiple products (e.g. shave gel, shampoo, deodorant, after shave, cologne) can help denote a brand image and will provide a wider market for the fragrance manufacturer.

However, products receiving the same consumer liking scores do not imply that they similarly provide same emotional benefits (Rétiveau, 2004). In addition, the same liking scores do not indicate how and/or when a consumer is going to use a product once purchased (Aarts, 2003). Therefore, identification of use occasions when certain fragrances are appropriate can aid a product developer to create a product that fits to a specific end use or multiple end uses.

References

Aarts, P. (2003). Fragrances with real impact. *Perfumer and Flavorist*, *28*(5), 34-49.

Aglioti, S. M., & Pazzaglia, M. (2011). Sounds and scents in (social) action. *Trends in Cognitive Science*, *15*(2), 47-55.

Anonymous. (2007, September 5). Trends in shower products. *Personal Care Magazine*. Retrieved from http://www.perfumerflavorist.com/fragrance/application/personal/9587667.html?page=1

Anonymous. (2008, January 22). Trends in women's fragrances. *Personal Care Magazine*. Retrieved from http://www.perfumerflavorist.com/fragrance/trends/13993217.html

Anonymous. (2012, October 4). Changing perceptions helping to significantly boost men's fragrance in China. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/consumers/men/172650271.html

Api, A. M. & Hakkinen, P. J. (2005). Fragrances and perfumes. In P. Wexler (Ed.), *Encyclopedia of Toxicology*, (2nd ed.) (pp. 382–384). Academic Press, New York, NY.

Aspria, M. (2009, January 19). Sex smells: odor, sexuality, and the erotic imaginary. *Scented Pages Perfume, Culture, and History.* Retrieved from http://scentedpages.com/pdf/aspria.pdf

Bain, H. (1997). Why people use perfumes. In P. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp. 232-239). London: Blackie Academic and Professional, Chapman and Hall.

Baron, R. A., & Kalsher, M. J. (1998). Effects of a pleasant ambient odor on simulated driving performance – the sweet smell of … safety? *Environment and Behavior, 30,* 535–552.

Boelens, H., & Haring, H. G. (1981). *Molecular Structure and Olfactory Quality*. Bussum, Netherlands: Internal Report, Naarden International.

Calkin, R. R., & Jellinek, J. S. (1994). *Perfumery: Practice and Principles*. New York: Wiley.

Chebat, J. C., & Michon, R. (2003). Impact of ambient odors on mall shoppers' emotions, cognition, and spending: A test of competitive causal theories. *Journal of Business Research*, *56*(7), 529–539. doi:10.1016/S0148-2963(01)00247-8

Chu, S., & Downes, J. (2000). Odour-evoked autobiographical memories: Psychological investigations of proustian phenomena. *Chemical Senses*, *25*(1), 111-116. doi: 10.1093/chemse/25.1.111

Deliza, R., & Macfie, H. J. H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies*, *11,*103-128.

Donna, L. (2009, December). Fragrance perception is everything relative? *Perfumer and Flavorist*. *34,* 26-35.

Dowthwaite, S. (2010, November). What is perfume? *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/106649278.html?page=2

Edwards, M. (2008). *Fragrances of the World: Parfums du Monde 2008* (24th ed.). Fragrances of the World, Sidney.

Ellison, S., & White, E. (2000). "When There's More to an Ad Than Meets the Eye," The Wall Street Journal, (November 24).

Falk, J. (2007, May). Emotional packaging. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/7320046.html

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/153230175.html?page=2

Fiore, A. M. (1992). Effect of composition of olfactory cues on impressions of personality. *Journal of Social Behavior and Personality*, *20,* 149–162.

Gilbert, A. N. (2008). *What The Nose Knows: The Science of Scent in Everyday Life.* New York: Harper Perennial.

Gleason-Allured, J. (2008, October). Scentworld 2008 report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist.com/events/coverage/31286474.html

Gleason-Allured, J. (2010, January). Fine fragrance's new reality. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93722124.html?page=2

Gleason-Allured, J., & Grabenhofer, R. (2010, May 13). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93719369.html

Goel, N., & Grasso, D. J. (2004). Olfactory discrimination and transient mood change in young men and women: variation by season, mood state, and time of day. *Chronobiology International, 21*, 691–719.

Graham, J. A. (1993). The psychology of fragrance. In Butler, H. (Ed.), *Poucher's Perfumes, Cosmetics and Soaps* (9th ed.) (pp. 728-739). London: Chapman and Hall.

Gregory, S. (2012, December 5). Enhancing emotional consumer connections. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/manufacturing/packaging/Enhancing-Emotional-Consumer-Connections-182215351.html

Grubow, L., & Kastner, A. (2011, December). Evolving gender stereotypes drive growth in Asian men's personal care. *GCI Magazine*. Retrieved from http://www.cosmeticsandtoiletries.com/formulating/category/menscare/134765353.html?page=1

Guerer, A. L. (2002). Olfaction and cognition: A philosophical and psychoanalytical view. In C. Rouby (Ed.), *Olfaction, Taste, and Cognition*. Cambridge, New York: Cambridge University Press.

Harper, M., & Burns, L. M. (2012, January). Making a fragrance connection through color. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/138487989.html

Hayden, N. (2007, November). Scent sleuth: Fragrance translations. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/bathbody/11118476.html

Hayden, N. (2008, May). Scent sleuth: Fragrance trends in hair care. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/18459104.html

Herman, S. (2012, May). Hot and cold. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/rd/ingredients/149267655.html?page=3

Hermans, D., Baeyens, F., & Eelen, P. (1998). Odours as affective-processing context for word evaluation: A case of cross-modal affective priming. *Cognition & Emotion, 12*, 601–613.

Herz, R. S. (1997). The effects of cue distinctiveness on odor-based context dependent memory. *Memory & Cognition*, *25*, 375-380.

Herz, R.S. (2004). A comparison of autobiographical memories triggered by olfactory, visual and auditory stimuli. *Chemical Senses, 29,* 217-224.

Herz, R.S. (2009). Aromatherapy facts and fictions: A scientific analysis of olfactory effects on mood, physiology and behavior. *International Journal of Neuroscience*, 119, 263-290.

Herz, R. S., Beland, S. L., & Hellerstein, M. (2004). Changing odor hedonic perception through emotional associations in humans. *Journal of Comparative Psychology*, *17,* 315-339.

Herz, R. S., & Cupchik, G. C. (1995). The emotional distinctiveness of odor-evoked memories. *Chemical Senses, 20,* 517-528.

Heuberger, E., Hongratanaworakit, T., Bohm, C., Weber, R., & Buchbauer, G. (2001). Effects of chiral fragrances on human autonomic nervous system parameters and self-evaluation. *Chemical Senses, 26*, 281–292.

Jellinek, J. S. (1992). Perfume classification: A new approach. In S. Van Toller & G. H. Dodd (Eds.), *Fragrance: The Psychology and Biology of Perfume* (pp. 229–242). London, U.K: Chapman and Hall.

Jellinek, P. (1951). *Die Psychologischen Grundlagen der Parfümerie*. Heidelberg: Alfred Hüthig Verlag.

Jellinek, P. (1997). The psychological basis of perfumery. In J. S. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp.1-162). London: Chapman and Hall.

John, T. V., Christensen, C., & Boyden, J. (2006). The benefits of fragrance materials: A Kant, I. (2006), *Anthropology from a Pragmatic Point of View*. Cambridge/New York: Cambridge University Press.

Knasko, S. C. (1992). Ambient odor's effect on creativity, mood, and perceived health. *Chemical Senses, 17*, 27–35.

Krishna, A. (2012). An integrative review of sensory marketing: Engaging the senses to affect perception, judgment and behavior. *Journal of Consumer Psychology*, 22. 332-351.

LeDoux, J. (2007). The amygdala. *Current Biology*, *17,* 868–874.

Millot, J. L., & Brand, G. (2001). Effects of pleasant and unpleasant ambient odors on human voice pitch. *Neuroscience Letters*, *297,* 61–63.

Milotic, D. (2003). The impact of fragrance on consumer choice. *Journal of Consumer Behaviour, 3,* 179–191. doi: 10.1002/cb.131.

Nute, G. R., Macfie, H. J. H., & Greenhoff, K. (1988). Practical application of preference mapping. In D. M. H. Thomson (Ed.), *Food Acceptability* (pp. 377-386). London: Elsevier.

Penning, A. (2011, January 19). The sweet smell of your brand's success. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/114217909.html

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. doi: 10.1016/j.foodqual.2011.07.006

Raudenbush, B., Meyer, B., & Epich, W. (2000). Effects of odor administration on objective and subjective measures of physical performance in athletes. *Chemical Senses*, *25,* 622.

Rétiveau, A. N. (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRetiveau2004.pdf?sequence=1

Rétiveau, A. N., Chambers IV, E., & Milliken, G. A. (2004). Common and specific effects of fine fragrances on the mood of women. *Journal of Sensory Studies*, *19,* 373–394. doi: 10.1111/j.1745-459x.2004.102803.x

Richardson, J. T. E., & Zucco, G. M. (1989). Cognition and olfaction: A review. *Psychological Bulletin*, *105,* 352-360.

Roberts, S. C., Little, A. C., Lyndon, A., Roberts, J., Havlicek, J., & Wright, R. L. (2009). Manipulation of body odour alters men's self-confidence and judgments of their visual attractiveness by women. *International Journal of Cosmetic Science*, *31,* 47–54. doi: 10.1111/j.1468-2494.2008.00477.x

Robin, O., Alaoui-Ismaili, O., Dittmar, A., & Vernet-Maury, E. (1999). Basic emotions evoked by eugenol odor differ according to the dental experience: A neurovegetative analysis. *Chemical Senses*, *24,* 327–335.

Ruffolo, R. (2011, November). Just follow your nose! *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/132994293.html?mobi=y

Salvador-Carreño, A., & Chisvert, A. (2005). Perfumes. In P. Worsfold, A. Townshend, & C. Poole, (Eds.), *Encyclopedia of Analytical Science*, (2nd Ed) (pp. 36–42). Academic Press, New York, NY.

Schiffman, S. S., Sattely-Miller, E. A., Suggs, M. S., & Graham, B. G. (1995). The effect of pleasant odors and hormone status on mood of women at mid-life. *Brain Research Bulletin*. *36,* 19–29.

Schroiff, H. W. (1991). All's well that smells well? *Seminar on Fine Fragrances and Fragrances in Consumer Products Using Research and Development and Optimisation*, London, 13–15 November, E.S.O.M.A.R., Amsterdam.

Snyder, M. (1990). Fragrance and social behavior. *Perfumer and Flavorist*, *15,* 37-38.

Snyder, M., & Attridge, M. (1995). The role of olfactory perception in social interaction. In A. N, Gilbert (Ed), Olfactory Research Fund, Ltd., *Compendium of Olfactory Research 1982-1994* (pp. 81-87). Dubuque, New York: Kendall Hunt Publisher.

Spangenberg, E. R., Sprott, D. E., Grohmann, B., & Tracy, D. L. (1996). Effects of gender-congruent ambient scent on approach and avoidance behaviors in a retail store. 7th annual retail strategy and consumer decision research symposium 2004. Retrieved from http://cn.scentair.com/uploads/media/researchspangenberggendercongruent.pdf

Stockhorst, U., & Pietrowsky, R. (2004). Olfactory perception, communication and the nose-to-brain pathway. *Physiology and Behaviour, 83,* 3-11.

Tanner, S. (2008, September). Materials: The scent of a winner. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/27917624.html

Towle, J. (2008, January). Revival in natural perfumery materials noted. *Personal Care Magazine*. Retrieved from http://www.personalcaremagazine.com/story.aspx?Story=3273

Tyrimou, N. (2012, September). Skin care market radiant for foreseeable future. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/skincare/167697355.html

Walker, K. (2009, August 14). Natural instincts: Global trends in women's fragrances. *Perfumer and Flavorist.* Retrieved from http://www.perfumerflavorist.com/fragrance/trends/53235747.html

Warrenburg, S. (2005). Effects of fragrance on emotions: Moods and physiology. *Chemical Sense*, *30*(1), 248-249.

Weber, S., & Heuberger, E. (2008). The impact of natural odors on affective states in humans. *Chemical Senses*, *33*(5), 441-447. doi: 10.1093/chemse/bjn011

Willander, J., & Larsson, M. (2007). Olfaction and emotion: The case of autobiographical memory. *Memory and Cognition*, *35*(7), 1659-1663.

Wolfe, O., & Busch, B. (1991). Two cultures meet and create a third: From consumer goods and fine fragrances to new product concepts. *Seminar on Fine Fragrances and Fragrances in Consumer Products Using Research and Development and Optimization.* London, 13–15 November, E.S.O.M.A.R., Amsterdam.

Yenket, R., Chambers E. IV, and Adhikari, K. 2011. A comparison of seven preference mapping techniques using four software programs. *Journal of Sensory Studies,* 26, 135-150.

Zarzo, M. (2007). The sense of smell: Molecular basis of odorant recognition. *Biological Reviews*, *82,* 455–479.

Zarzo, M., & Stanton, D. T. (2009). Understanding the underlying dimensions in perfumers' odor perception space as a basis for developing meaningful odor maps. *Attention, Perception, and Psychophysics*, *71,* 225–247.

DETAILED MATERIALS AND METHODS

Chapter 3 - Materials and Methods

This study involved two "panels" who independently evaluated six cologne samples purposely made for men's personal care products. The first panel was that of a fragrance expert who performed descriptive sensory analysis for odorant characteristics. The second panel was a total of 240 consumers who evaluated samples and provided responses related to hedonic reaction, term association, use occasion, potential application for personal care products, and expectation of functional benefits. A wide range of univariate and multivariate statistical techniques were used to analyze the obtained data. The specific information is provided below.

Odorants Selection

To reduce the variability of gender association category of fragrance, this study focused on only the masculine odorants. Odorant samples were selected from a pool of masculine fragrances used for personal care products. Three personal care researchers screened the samples. The researchers selected four representative odorant samples and one commercially available cologne for this study. The samples had olfactory characteristics that smelled different from each other. Additionally, each sample had diverse characteristics that covered at least 2-3 subfamilies in Edward's fragrance wheel (Edwards, 2008) (Table 3.1).

Table 3.1 Selected Odorant Samples and Their Class and Description

Odorant type	Sample	Edwards' classification	Description
Odorant purposely made for personal care product	112	Mossy woods - Citrus	Chypré: moss, citrus, floral, woody
	357	Soft floral - Green	Soapy, vanilla, musk, rose
	413	Floral-Citrus	Lime, violet
	958	Oriental-Floral	Lavender, coconut, anise, musk
Commercial cologne	504	Aromatic	Fougère: geranium, cedar, lime, musk

Odorant Evaluations

Descriptive Evaluation of Odorant Samples by a Fragrance Expert

1. Sample Preparation

Throughout the course of the study, all odorant bottles were stored at room temperature. A 0.5 mL sample of each odorant was transferred on a cotton swab (Qtips®, Uniliver, USA) using a disposable 1 mL tuberculin syringe (sterilized) (Fisher Scientific Inc., PA). The cotton swaps were pre-cut in half length (4 cm). The scented cotton swab was then placed with the swab side down in an evaluation container with a 3-digit code. The type of container used in this study was an amber vial screw-thread bottle with a black screw-top cap and a white liner (3.7 mL) (Fisher Scientific Inc., PA). Each container was immediately and tightly closed immediately after the scented swab was inserted.

The samples were then delivered to a fragrance expert for the odor evaluation. The odorant samples were held in containers at least 20 hours to allow the odorants to reach equilibrium prior sample evaluation.

2. Sample Presentation and Evaluation

Each sample was evaluated in a random order by a fragrance expert who had 10 years of experience in fragrance evaluation at a fragrance house company. The fragrance expert was not told anything about the cologne samples. The expert evaluated odorant samples and generated descriptive terms to characterize each odorant sample. Necessary references, i.e. fragrance compounds, were used to anchor and calibrate the intensity measurement on a 5-pt numerical scale (0 = none and 5 = extremely high intensity). The evaluation sessions were conducted in 1-2 hour sessions in the morning.

Consumer Test

One hundred fifty of each male and female consumer at age of 18-49 years old were randomly selected from 976 qualified respondents who completed the Big-Five personality inventory. The participants completed the screening and the questionnaires via an internet using a Home Use Test (HUT) method. Detailed information was provided in the section below.

Respondents Selection

Potential respondents received an email notifying about an upcoming consumer test. They were asked to complete pre-recruitment (screening survey [Appendix A]) and a Big-Five personality inventory (Appendix B) (Benet-Martinez & John, 1998) for personality classification. A total of 976 consumers, both male and female, within an age range of 18-49 years old, across the United States (US) completed the personality survey and claimed to be either men who used cologne, fragrance, or fragranced personal care products (e.g., deodorants, shave gel/cream, shave balm, body wash, etc.) or women were who liked the smell of cologne, fragrance, or personal care products on men or were attracted to a man who uses these products.

- Big Five Inventory Questionnaire (BFI)

Researchers used the Big-Five Inventory (BFI) (Benet-Martínez & John, 1998) of personality traits to measure participant personality traits. This self-inventory questionnaire was developed to assess the high-order personality trait categories of Openness to experience, Conscientiousness, Extraversion, Agreeableness, Neuroticism (OCEAN).

The questionnaire for this study contained 44 short statements representing five personality dimensions with each personality category containing 8-10 statements. The respondents read a series of statements and indicated how each statement represents them on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

- Sample Preparation for Consumer Research

The samples were prepared using the same procedure used for descriptive analysis. All the samples (with 3 digit codes) were packed, individually, in a clear bubble bag with a lip and tape (3.5x4") (Staples®, USA) to protect them from damage. Once each sample was packed in a bag, a label having a letter "A" was placed onto the bag containing the sample to be evaluated first. Others bags containing coded samples were labeled B, C, D, and E, which represented the evaluation order from 2nd to 5th. The determination of order was determined based on a modified Williams Latin square design (Meilgaard, Civile, & Carr*,* 2007) that allowed samples to be tested to account for both positional and order effects. All five samples were packed in a postage box and sent out to consumers using the United States Postal Office (USPS). The sample set was assumed to arrive at the destination within 1-3 business days.

The test was conducted in October – November 2010 when the average temperature across country was at the range of 42-56 F° (National Oceanic and Atmospheric Administration [NCDC] 2012). This information suggested that the fragrance samples were not subject to undue deterioration during transport.

Internet Survey

Prior to the sample shipment, an email was sent to the target consumers to inform them about their qualification. Then, after the samples were shipped, each consumer received another email notifying them that a package was coming to their address and providing the test schedule for 5 odorant samples. The test schedule indicated the dates to complete each sample. The consumers were asked to evaluate each sample anytime within the 3 day period assigned for that sample at their home, and then they were asked to evaluate other odorant samples in the following 3 day period. The online-survey for each sample was only available on the specified

dates. The consumers could not revisit the survey and they were not allowed to do a make-up test, if missed. The test took approximately 2 weeks for the consumers to complete.

On the evaluation day, respondents were asked to log in to the website. They were welcomed by an introduction page and then they were asked to indicate the survey session (survey A to E). Then, the consumers were asked to register the sample code appearing on the label of the sample vial and completed the questionnaires which addressed in the following section.

Questionnaires

Within each survey, the participants were asked to complete 6 set of questions (Appendix C). They were asked to evaluate their current emotions prior to sample evaluation. Then they were asked to sniff a sample and indicate how much they liked the odor as well as re-evaluate their emotions after they had smelled the sample. The survey continued by asking participants to indicate the agreement/disagreement on use occasion, potential application in personal care products, and expectation of functional benefits. Lastly, they were asked to indicate the degree of term association toward an odorant sample. The survey took 20-30 minutes to complete, depending on personal speed.

- Emotion Questions and Modification

The ScentMove™ Questionnaire (Porcherot et al., 2010) for measuring participant emotion was used. The respondents rated the pertinence of each of the six series of three feeling terms to describe their feelings before and right after smelling the odorant on a 10-cm linear scale ranging from “no feelings” to “very intense feelings”. To maximize the scale, researchers translated the participants’ ratings to numeric value from 0 to 100.

The emotion series and their feeling terms are (1) *Pleasant feeling* (*happiness*, *well-being*, *and pleasantly surprised*), (2) *Sensuality* (*romantic*, *desire*, and *in love*), (3) *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), (4) *Relaxation* (*relaxed*, *serene*, and *reassured*), (5) *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and (6) *Refreshment* (*energetic*, *invigorated*, and *clean*).

Before analyzing the data, researchers subtracted the emotion ratings prior to odorant evaluation from the emotion ratings after smelling, to determine the change in individuals' psychological states (Bhumiratana, 2010; Gibson, 2006).

- Odorant Acceptance

For the hedonic response, participants were asked to indicate how much they liked or disliked each odorant sample's smell on a 9-point scale, where 1 = dislike extremely, to 9 = like extremely.

- Agreement/Disagreement on Use Occasion

Respondents were asked to identify the level of their agreement or disagreement toward 11 different situations on a 5-point Likert scale (1 = strongly disagree, to 5 = strongly agree). The statement "If I were going to wear this cologne, I would wear it:" was used to introduce each of the given situations that consisted of time of day, seasons, activities, and occasions. These situations were modified from previous studies (Aarts, 2003; Rétiveau, 2004).

- Agreement/Disagreement on Potential Application in Personal Care Products

Ten personal care categories, modified from Wormuth, Scheringer, & Hungerbühler (2005), were presented to participants. For each personal care category, participants were asked to indicate how much they agree or disagree on the appropriateness of a particular scent as

reasonable for a particular category on a 5-point Likert scale (1 = disagree strongly to 5 = agree strongly). The question "Do you think this scent is suitable to be found in…?" was used to introduce each product category to participants.

- Agreement/Disagreement on Expectation of Functional Benefits.

To investigate the appropriateness of functional benefits as related to odorants, 17 functional benefits were presented to participants. Participants were asked to determine if they would have expectations of the specified functional benefits from the personal care product for each scent they smelled. A 5-point Likert scale (1 = disagree strongly, to 5 = agree strongly) was provided to participants to indicate their agreement/disagreement on each functional benefit.

The functional benefit items were selected from a pool of terms used in commercially available personal care products. The terms that had similar definition were grouped together. One to two terms that represent each subgroup were selected by three personal care experts. The select terms included '*hydrate'*, '*recharge*/*energized'*, '*refreshing*/*invigorating'*, 'deep/*ultimate clean'*, '*smooth'*, '*soften'*, '*cooling'*, '*heating'*, '*odor protection'*, and '*clear skin'* for example (Appendix C).

- Degree of Sensory and Consumer Terms Associated with an Odorant

A checklist consisting of an odor strength rating and 16 sensory and consumer terms, modified from previous studies and articles (Jellinek, 1992; Higuchi, Shoji, & Hatayama, 2004; Gleason-Allured, 2008; Zarzo & Stanton, 2009; Falk & Penning, 2012; Lindqvist, 2012a; Porcherot et al., 2012), was used to evaluate the scents. Respondents were asked to indicate the level of terms associated with an odorant using a numerical scale, ranging from 1 = not at all, to 5 = extreme. The sixteen terms, included '*bold'*, '*heavy'*, '*modern'*, '*crisp'*, '*familiar'*, '*natural'*, and '*distinctive'* for example.

Data Processing

The responses obtained from consumers were analyzed using univariate and multivariate statistical analysis and the responses from the fragrance expert were analyzed using multivariate statistical analysis. The univariate statistical analysis included Analysis of Variance (AOV) and multiple t-tests to determine significant differences. Multivariate statistical analyses were applied to the data sets to investigate and interpret underlying relationships among variables and odorant samples using Principal Components Analysis (PCA), as well as, relationships between two set of variables using Partial Least Squares Regression (PLSR). The analyses and their procedures are summarized (Table 3.2) and discussed in the following sections.

Table 3.2 Overview Summary for Statistical Analyses Used in This Study

Variable			Significant difference (AOV)	Relationship of variables	
Category	Source	Number		Samples (PCA)	Variable Type (PLS)
Descriptive sensory profile	Expert	18	-	✓	x
Emotion response	Consumers	6	✓	✓	y
Hedonic	Consumers	1	✓	-	x
Use occasion	Consumers	11	✓	✓	y
Potential application	Consumers	10	✓	✓	y
Expectation of functional benefits	Consumers	17	✓	✓	y
Term association	Consumers	17	✓	✓	y

Personality Classification of Consumers: A Comparison of Variables, Standardization, and Clustering Methods (Chapter 4)

- Data Preparation

For this study, the data was prepared according to previous studies (McCrae & Costa, 1999; John, Naumann, & Soto, 2008); raw data was collected and prepared for analyses by separating the positive and negative statement ratings. Negative statements were reversed by subtracting the answer by 6 then taking the absolute value of the answer as the final score. For

example, if the score is 5 then the reversed absolute score will be 1 (e.g., a score of 1 becomes 5, 2 becomes 4, 3 becomes 3, 4 becomes 2, and 5 becomes 1). Subsequently, forty-four variables (FFV) including those with reversed items were standardized. The standardization of each item was done by calculating the difference between a score and the mean score (for that item) divided by standard deviation (for that item).

To calculate five factors scores (FFS) the items within the same category were averaged to obtain the five domains (E = Extraversion, A = Agreeableness, C = Conscientiousness, O = Openness, N = Neuroticism). Researchers computed these transformed five personality domains, and subsequently, the factor scores were standardized in the same manner as the FFV. Researchers used a total of four data sets (i.e., unstandardized FFV, standardized FFV, unstandardized FFS, and standardized FFS) for further analyses.

The prepared data set was subjected to K-means non-hierarchical clustering methods using XLSTAT (version 2010, Addinsoft, New York, NY, USA).

- Data Analysis

The prepared data sets (DS1, DS2, SDS1, and SDS2) were subjected to cluster analysis, i.e., Ward's hierarchical clustering and K-means non-hierarchical clustering methods. Both methods were used to classify respondent personalities using different data sets: UDS1, UDS2, SDS1, and SDS2. These clustering methods were completed using PROC CLUSTER of SAS® (version 9.2; SAS Institute, Cary, NC, USA) and XLSTAT (version 2010, Addinsoft, New York, NY, USA), respectively. Researchers execute PCA by using Unscrambler® (version 9.7, CAMO Software Inc., Woodbridge, NJ, USA) to create maps that were used to verify, evaluate, and fine-tune classification results of clustering methods (Johnson, 1998).

For the obtained personality clusters, researchers analyzed ratings using a GLIMMIX model (SAS, 1998) where they treated the personality cluster as fixed effects. Respondent within a cluster was treated as a random effect. Additionally, within each personality statement researchers collected the difference between maximum and minimum ratings to demonstrate variation of the obtained personality clusters.

- Data Visualization

This study incorporated spider (radar) plots to provide visual aids for comparison between clustering methods and number of input variables for classification. Researchers used the mean scores of personality variables from each classified group to create a spider plot which they utilized to compare the differences of personality patterns between: 1) k-means and Ward's clustering methods for classifying FFS variables, and 2) k-means and Ward's clustering methods for classifying FFV.

For comparison, all four data sets were plotted in two forms (i.e., 5-component spider plots and 44-component spider plots) for a total of eight data sets. For groups classified by subjecting both unstandardized FFV and FFS in cluster analyses, researchers used these variables to illustrate spider plots (represented as 44-component spider plot) and the 44 variables were computed to five variables and then used to illustrate 5-component spider plots.

The FFS illustrated five computed spider plots. Additionally, the five computed variables were reversed to the original 44 variables and used to create spider plots.

Participant Selection Process

The respondents then were divided into subcategories based on demographic information (gender and age [18-25, 26-35, and 36-49]) and personality patterns (discussed in Chapter 4). A total of 300 respondents were selected and participated in the study. Fifty consumers were

equally and randomly selected from 6 groups (2 genders x 3 age groups). Additionally, the selected consumers also represented 5 different personality patterns (55-73 respondents per personality group).

Effect of Demographic Characteristics on Olfactory Responses to Masculine Fragrances (Chapter 5)

- Demographic Classifications

Two data sets were generated based on participant gender and age, respectively. Researchers analyzed each data set for significant differences of responses, obtained from participants in each subgroup (i.e., male and female, or age 18-25, 26-35, and 36-49).

- Analysis of Significant Difference for the Variables of Participants Who had Different Demographic Characteristics

Each data set was individually subjected to Analysis of Variance (AOV) using the GLIMMIX procedure at a 5% level of significance (SAS®) performed on the variables. The odorant, demographic group (i.e., age and gender), and interaction of odorant by demographic group were used as fixed effects. Each participant was included in the model as a random effect. Mean separation tests (multiple t-tests') were carried out to determine if significant differences among demographic groups existed.

For each response variable category, the average responses of all five odorant samples, rated by participants from different groups, were illustrated in bar charts with an asterisk (*) representing a significant difference between participant demographics ($p<0.05$).

Effect of Personality Differences on Olfactory Responses to Masculine Fragrances (Chapter 6)

- Personality Classification

The classification of participants based on personality was conducted using two different perspectives. The first classification was made based on the similarity/dissimilarity of personality patterns of all five personality dimensions. The participants were classified into 5 personality patterns, as discussed in Chapter 4.

The second personality classification was made based on each of the big-five personality dimensions. Each dimension was used for categorizing participants into groups based on the strength of personality (very low, low, moderate, high, and very high). Participants who evaluated themselves within two-three continuous levels of a personality may be combined together if the number of participants in each level was less than 20. A total of five data sets were generated.

- Analysis of Significant Difference for the Variables of Participants from Different Personality Groups

A total of six data sets (personality patterns and each of the five personality dimension) individually subjected to Analysis of Variance (AOV) using the GLIMMIX procedure at a 5% level of significance (SAS®) performed on the variables. The odorant, personality (i.e., pattern and the five dimensions), and interaction of odorant by personality were used as fixed effects. The respondent was included in the model as a random effect. Mean separation tests (multiple t-tests') were carried out to compare the means to determine if significant differences among personality pattern (or personality level).

For each response variable category, the average responses of all five odorant samples rated by participants from different groups were illustrated in bar charts with asterisk (*) representing a significant difference among groups of participants ($p<0.05$).

Influence of Pleasant Odorants on Subjective Responses: the Congruency of Odorants and Olfactory Responses (Chapter 7)

- Data Preparation for Emotion Dimensions

The emotion ratings prior to odorant evaluation were subtracted from the emotion ratings during the evaluation to reduce the impact of a persons' initial psychological state, before analyzing the data (Bhumiratana, 2010; Gibson, 2006).

- Analysis of Significant Difference for the Variables Obtained from Participants

Each variable obtained from all participants were subjected to Analysis of Variance (AOV), using the GLIMMIX procedure at the 5% level of significance (SAS®), to determine if there is, at least, a significant difference on odorant samples. Mean separation tests (multiple t-tests) were carried out to compare the means if significant differences existed.

For each response variable category, average scores of five odorant samples were illustrated in bar charts with asterisk (*) representing a significant difference between participant groups ($p<0.05$).

Consumer Classification Based on Olfactory Acceptance Patterns (Chapter 8)

- Data Preparation: Consumer Classification Based on Similarity of Liking Pattern

The hedonic score of all 5 odorants rated by each consumer were subjected to Ward's hierarchical clustering method using PROC CLUSTER of SAS® (version 9.2; SAS Institute, Cary, NC, USA).

- Internal Preference Mapping and Consumer Segmentation

The Unscrambler® 10.2 (version 10.2, CAMO Software Inc., Woodbridge, NJ, USA) was used to conduct internal preference mapping using Principal Component Analysis (PCA) to locate odorant samples on the map using hedonic scores of all consumers. In addition, the mean hedonic score of each odorant sample from each consumer cluster was subjected to PCA for ease of interpretation (Schilch, 1995; Yenket, 2011).

The hedonic scores of all consumers were subjected to cluster analysis, using Ward's hierarchical clustering method of SAS® (version 9.2; SAS Institute, Cary, NC, USA).

- Analysis of Significant Differences for the variables obtained from consumers

For each consumer cluster, liking data were analyzed for Analysis of Variance using a GLIMMIX model at 5% level of significance (SAS®). The odorant, consumer segment, and interaction of odorant by consumer segment were treated as fixed effects. Respondent within a cluster was treated as a random effect. Mean separation tests (multiple t-tests) were carried out to compare the means if significant difference exists.

- Relationship between Specific Consumer Groups and Olfactory Responses (for supplementary results)

For each consumer cluster, the mean scores of collected variables toward five odorant samples were also subjected to the Unscrambler® 10.2 (CAMO Software Inc., Woodbridge, NJ,

USA) for conducting Partial Least Square Regression (PLSR) to investigate relationship between two sets of variables (Martens & Martens, 1986).

The descriptive sensory profile obtained from a fragrance expert and consumer's olfactory liking score (independent variables, X-variables) were used as predictors of consumer variables: emotion experience, potential occasional usage, potential application in personal care category, expectation of functional benefits and term association with odorants (dependent variables, Y-variables). All variables were standardized prior to the PLSR analysis to eliminate differences in scale types.

Effect of Olfactory Liking Patterns of Odorants on Associations between Consumer Description and Odorants (Chapter 9)

- Consumer Segmentation Using Liking Pattern

The hedonic score of all five odorants rated by each consumer were subjected to Ward's hierarchical clustering method using PROC CLUSTER of SAS® (version 9.2; SAS Institute, Cary, NC, USA). Researchers applied the clustering method to classify liking patterns of respondents. Hierarchical dendogram and cubic clustering criterion were plotted to assist in decision making for the numbers of consumer segments based on the similarity of liking patterns.

For each consumer segment, liking data were analyzed using a GLIMMIX model (SAS, 1998) where an odorant, a consumer cluster, and an interaction of odorant by consumer cluster were treated as fixed effects. A respondent within a cluster was treated as a random effect.

- Relationship of Olfactory Preference and Consumer Perception of Terms Associated with Odorant Samples

The level of associations of sensory and consumer-related terms for respondents within all consumer clusters were analyzed by Analysis of Variance (AOV) using the GLIMMIX procedure at the 5% level of significance (SAS®). The odorant, consumer segment, and interaction of odorant by consumer segment were used as fixed effects. The respondent was included in the model as a random effect. Mean separation tests (multiple t-tests) were carried out to compare the means if a significant difference existed.

Mean scores for variables (sensory and consumer-related terms) obtained from consumer segments were labeled with a sample code (112, 357, 413, 504, and 958) and a letter represented each consumer segment (A, B, C, D, and E). For example, the code 112-A represented the sample 112 that was evaluated by consumers from segment A. The mean responses of all odorant samples from all consumer clusters were subjected to the Unscrambler® 10.2 (CAMO Software Inc., Woodbridge, NJ, USA) for conducting Principal Component Analysis (PCA). The columns represented collected variables where the rows represented odorant samples. The PCA, using a correlation matrix, was used for generating a perceptual map for sensory and consumers-related terms associated with the five odorants.

- Correlation Analysis of Odorant Liking toward a Set of Terms Associated with Odorant Samples

Researchers calculated Pearson correlation coefficients using the PROC CORR function (SAS ®) to investigate correlations between odorant liking scores of all five consumer segments and their association level of sensory and consumer-related terms at a 95% confidence interval. Terms that highly correlated to odorant liking ($r \geq \left| 90 \right|$) were removed from the data set to

prevent them from biasing further analysis by including multiple collinear terms that basically were used by consumers as surrogates for liking.

- Relationship of Hedonicity to Sensory and Consumer-Related Terms of Odorant Samples

For each odorant sample, the mean scores of odorant liking and association level of sensory and consumer-related terms of all five consumer segments were subjected to the Unscrambler® 10.2 (CAMO Software Inc., Woodbridge, NJ, USA) for conducting Partial Least Square Regression (PLSR) to investigate the relationship between two sets of variables (Martens & Martens, 1986). The sensory and consumer-related terms (independent variables, X-variables) were used as predictors of an odorant liking (dependent variable, Y-variable). In addition, all variables were standardized prior to the PLSR and a correlation analysis to eliminate differences in scale types.

Prediction of Fragrance Acceptance Patterns Based on Demographic and Personality Characteristics (Chapter 10)

- Data Preparation

The 9-point hedonic scores were transformed by whether the scores fell within the range of dislike extremely to neither like or dislike (1-5 points), or the range of like slightly to like extremely (6-9 points). The transformed values were 0 (if the hedonic score was lower than 6) and 1 (if the hedonic score was equal or higher than 6), and the new values represent whether the consumers disliked or liked odorant samples, respectively.

- Logistic Regression

Researchers used logistic regression analysis for predicting the binary response (dislike and like) by using demographic and personality information as predictors. The demographic

information consisted of two categorical variables, age (18-25, 26-35, and 36-49 years old) and gender. Each computed consumer personality characteristics (e.g., openness of experience, conscientiousness, extraversion, agreeableness, and neuroticism) consisted of 5 points indicating a personality level from low (1) to high (5). The computed characteristics were used because the use of the full 44 variables would have made the analysis cumbersome in this case.

Scientists used a logistic regression analysis (PROC LOGISTIC) in SAS to investigate the effectiveness of an individual demographic and personality segmentation (a single-variable model) for explaining consumer liking and predicting consumer liking based on those segmentation criteria. The parameter estimate, probability (Pr> χ^2), and odds ratio were shown to indicate effectiveness of each segmentation criterion. For these analyses, age 18-25, females, and scores of 1 on personality traits were used as baseline scores for comparing differences versus other ages, gender, or scores respectively.

References

Aarts, P. (2003). Fragrances with real impact. *Perfumer and Flavorist*, *28*(5), 34-49.

Benet-Martínez, V., & John, O.P. (1998). Los cinco grandes across cultures and ethnic groups: Multitrait method analyses of the Big Five in Spanish and English. *Journal of Personality and Social Psychology, 75*, 729-750.

Bhumiratana, N. (2010). *The Development of an Emotion Lexicon for the Coffee Drinking Experience (Doctoral Dissertation).* Retrieved from http://krex.k-state.edu/dspace/handle/2097/7010

Edwards, M. (2008). *Fragrances of the World: Parfums du Monde 2008* (24th ed.). Fragrances of the World, Sidney.

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/153230175.html?page=2

Gibson, E. L. (2006). Emotional influences on food choice: Sensory, physiological and psychological pathways. *Physiology & Behavior*, *89*(1), 53-61. doi.10.1016/j.physbeh.2006.01.024

Gleason-Allured, J. (2008, October). Scentworld 2008 report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist.com/events/coverage/31286474.html

Higuchi, T., Shoji, K., & Hatayama, T. (2004), Multidimensional scaling of fragrances: A comparison between the verbal and non-verbal methods of classifying fragrances. *Japanese Psychological Research*, *46* (1), 10–19. doi: 10.1111/j.1468-5884.2004.00232.x

Jellinek, J. S. (1992). Perfume classification: A new approach. In S. Van Toller & G. H. Dodd (Eds.), *Fragrance: The Psychology and Biology of Perfume* (pp. 229–242). London, U.K: Chapman and Hall.

Lindqvist, A. (2012). Perfume preferences and how they are related to commercial gender classifications of fragrances. *Chemosensory Perception*, *5*(2), 197-204. doi: 10.1007/s12078-012-9119-7

Martens, M., & Martens, H. (1986). Partial least squares regression. In J. R. Piggott (Ed.), *Statistical Procedures in Food Research* (pp. 293-359). London and New York: Elsevier Applied Science.

Meilgaard, M., Civile, G. V., & Carr, B. T. (2007). *Sensory Evaluation Techniques (4th ed.)*. Florida, USA: CRC Press.

National Oceanic and Atmospheric Administration. (2012). *National Climatic Data Center (NCDC): The World's Largest Active Archive of Weather and Climate Data Producing and Supplying Data and Publications for the World*. Retrieved from http://www.ncdc.noaa.gov

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. doi: 10.1016/j.foodqual.2011.07.006

Porcherot, C., Delplanque, S., Raviot-Derrien, S., Le Calvé, B., Chrea, C., Gaudreau, N., Cayeux, I. (2010). How do you feel when you smell this? Optimization of a verbal measurement of odor-elicited emotions. *Food Quality and Preference, 21*, 938–947

Rétiveau, A. N. (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRetiveau2004.pdf?sequence=1

SAS®. (2008). SAS/STAT® 9.2 user's guide, the Glimmix procedure (book excerpt). Statistical Analysis System, V.8 (SAS: Cary, NC). Retrieved from http://support.sas.com/documentation/cdl/en/statugglmmix/61788/PDF/default/statugglmmix.pdf

Schlich, P. (1995). Preference mapping: Relating consumer preferences to sensory or instrumental measurements. In P. Étiévant & P. Schreier (Eds.), *Bioflavour'95-Analysis/Precursor Studies/Biotechnology* (pp. 231-245). Dijon, France: INRA.

Wormuth, M., Scheringer, M., & Hungerbühler, K. (2005), Linking the use of scented consumer products to consumer exposure to polycyclic musk fragrances. *Journal of Industrial Ecology*, *9,* 237–258. doi: 10.1162/1088198054084626

Yenket, R. (2011). *Understanding methods for internal and external preference mapping and clustering in sensory analysis (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/8770/RenooYenket2011.pdf?sequence=9

Zarzo, M., & Stanton, D. T. (2009). Understanding the underlying dimensions in perfumers' odor perception space as a basis for developing meaningful odor maps. *Attention, Perception, and Psychophysics*, *71,* 225–247.

SECTION 1: CONSUMER SEGMENTATIONS AND SELECTION BASED ON PERSONALITY PATTERN

Chapter 4 - Personality Classification of Consumers: A Comparison of Variables, Standardization, and Clustering Methods

Abstract

The use of personality trait measurement is increasing in sensory evaluation for linking certain variables (i.e., consumption behavior and product preferences) to particular attributes. For this study, 976 consumers rated agreement on 44 statements from the Big-Five Inventory using a 5-point Likert-type scale. Data handling methods for personality segmentation were compared: (a) original 44 variables versus the five computed personality variables, (b) standardization versus non-standardization of data, and (c) K-means versus Ward's hierarchical clustering method used with Principal Component Analysis (PCA).

Results indicate using the five computed variables in mapping gave higher percentages of explained variability due to the small number of input variables. However, maps created from the 44 individual variables illustrated that participants were distributed throughout and separated visually into groups. Standardization of the data set did not affect mapping or classification. K-means and Ward's clustering methods provided different classification results within the same data set.

Results suggest that when using the Big-Five personality traits measurement, the original 44 unstandardized variables and K-means clustering should be used for obtaining consumer segmentation because it captures variability from all 44 variables obtained from a large population. The maps were easy to separate participants into groups.

Practical Applications

This study suggests that full data sets rather than computed variables should be used as when conducting consumer studies using personality traits from the Big-Five personality measurement tool. Further it is not necessary to standardize the data saving additional time in data preparation. However, the clustering method for placing consumers into personality groups does impact the study and based on this study, researchers recommend K-means clustering.

Introduction

Individuals possess a set of characteristics called personality, and those characteristics influence each person's pattern of thought, emotion, motivation, and behavior. Personality traits tend to be stable over time where emotions, are more transient (Revelle & Scherer, 2009). For decades, researchers in psychology have conducted studies on personality (Goldberg, 1990) and developed several trait theories explaining and classifying personality structure. One personality trait theory describes personality traits in a five-dimension personality framework known as the "Big-Five" of human personality (Goldberg, 1990). The five-dimensions include: extraversion (sociable, assertive, talkative), neuroticism (anxious, irritable, emotional), agreeableness (sympathetic, kind, understanding), conscientiousness (organized, reliable), and openness to experience (creative, imaginative, innovative) (Goldberg, 1990; McCrae & Costa, 1999).

Researchers developed numerous self-report questionnaires and currently use them for research on personality. The questionnaires consist of 18 to 200 trait adjectives or statements relating to the five-dimensions of personality (Costa & McCrae, 1992; McCrae & Costa, 1999; Salgado, 2003). The collected responses were averaged within each personality category and presented as five-comprehensive dimensions (Benet-Martínez & John, 1998; McCrae & Costa, 1999). Researchers studying the understanding of relationships between personality and other

personal variables, e.g., behavior (O'Malley & Gillette, 1984) and mood (Harris & Lucia, 2003), widely use self-report questionnaires as part of their research.

Certain sensory and consumer studies use personality traits to classify consumers into groups and explain the underlying principles of consumption patterns (Wansink, Steven, & Sonka, 2004) and product preference (Rétiveau, 2004). However, researchers should apply Big-Five personality factors for consumer segmentation with caution because the five-representative personality factors were computed from numerous items on the questionnaire. The responses of one individual for each item may be affected by this computation (i.e., the consumers who received the same level of extroversion may respond to the items from extraversion category differently). Consequently, sensitivity needed to differentiate individuals may be reduced and affect the research findings.

Researchers use clustering techniques to classify consumers with similar response patterns. However, Yenket et al. (2011) suggest that researchers must use various clustering methods, and therefore, determine which method works best for a specific data set and objectives. Researchers commonly use Ward's hierarchical clustering method and K-means non-hierarchical clustering method in sensory and consumer studies. Ward's hierarchical method groups data points into clusters in a nested sequence of clustering (Johnson, 1998). However, K-means non-hierarchical clustering method groups data points into clusters by using dissimilarity measurement to measure the distances between each point and the cluster seeds (Johnson, 1998). Additionally, information obtained from cluster analysis may be used along with principal components analysis (PCA), which visually displays distinct groups in various dimensions (Baxter, 1995).

There are two data preparations for personality comparison: standardized data and unstandardized data. Schmitt et al. (2007) converted raw original personality scores to standardized scores for ease of interpretation and comparison. However, Johnson (1998) recommended standardization of data should be used only when measured variables are in completely different units.

This study's objective investigates the best data handling for personality traits assessment. The objectives were to compare data handling for consumer segmentation using 1) the original 44-variables versus five computed personality variables, 2) standardized versus unstandardized data, and 3) k-means versus Ward's hierarchical clustering methods.

Materials and Methods

Participants

A total of 976 male and female respondents across the United States (US) aged 18-60 years participated in this study; respondents had experience completing questionnaires via the internet.

Questionnaire

Researchers used the Big-Five Inventory (BFI) (Benet-Martínez & John, 1998) of personality traits to measure participant personality traits. This self-inventory questionnaire was developed to assess the high-order personality trait categories of Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN). Prior research demonstrates BFI to be a quick and efficient personality assessment (Benet-Martínez & John, 1998), thus scientists from various countries apply this assessment to their research (Schmitt et al., 2007).

The questionnaire for this study contained 44 short statements representing five personality dimensions with each personality category containing 8-10 statements (Benet-Martínez & John, 1998). The participants read a series of statements and indicated how each statement represents them on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

For this study, researchers conducted the self-inventory survey via the internet. The internet-based version of the questionnaire provided equivalent results when compared to a paper-based version intern of distributions, validity, and personality structure (Salgado & Moscoso, 2003; Ritter et al. 2004; Holden & Troister, 2009). Additionally, participants perceived the internet-based version as more comfortable and less intimidating when compared to a conventional paper-based questionnaire (Salgado & Moscoso, 2003; Ritter et al., 2004).

Data Preparation

For this study, researchers conducted data preparation according to previous studies (McCrae & Costa, 1999; John et al. 2008); they also collected raw data and prepared it for analyses by separating the positive and negative statement ratings. Negative statements were reversed by subtracting the answer by 6 then taking the absolute value of the answer as the final score. For example, if the score is 5 then the reversed absolute score will be 1 (e.g., a score of 1 becomes 5, 2 becomes 4, 3 becomes 3, 4 becomes 2, and 5 becomes 1). Subsequently, forty-four variables (FFV) including those with reversed items were standardized. Standardization of each statement (item) was done by computing the difference between a score and the mean score (for that item) by standard deviation (for that item).

To calculate five factors scores (FFS) the items within the same category were averaged to obtain the five domains (E = Extraversion, A = Agreeableness, C = Conscientiousness, O =

Openness, N = Neuroticism). Researchers computed these transformed five personality domains, and subsequently, the factor scores were standardized in the same manner as the FFV. Researchers used a total of four data sets (i.e., unstandardized FFV, standardized FFV, unstandardized FFS, and standardized FFS) for further analyses.

Data Analysis

The prepared data sets (DS1, DS2, SDS1, and SDS2) were subjected to cluster analysis, i.e., Ward's hierarchical clustering and K-means non-hierarchical clustering methods. Both methods were conducted to classify participant personalities using different data sets: UDS1, UDS2, SDS1, and SDS2. These clustering methods were completed using PROC CLUSTER of SAS® (version 9.2; SAS Institute, Cary, NC, USA) and XLSTAT (version 2010, Addinsoft, New York, NY, USA), respectively. Researchers conducted PCA by using Unscrambler® (version 9.7, CAMO Software Inc., Woodbridge, NJ, USA) to create maps that were used to verify, evaluate, and fine-tune classification results of clustering methods (Johnson, 1998).

For the obtained personality clusters, researchers analyzed ratings using a GLIMMIX model (SAS, 1998) where they treated the personality cluster as fixed effects. Participants within a cluster were treated as a random effect. Additionally, within each personality statement researchers collected the difference between maximum and minimum ratings to demonstrate variation of the obtained personality clusters.

Data Visualization

This study incorporated spider (radar) plots to provide visual aids for comparison between clustering methods and number of input variables for classification. Researchers used the mean scores of personality variables from each classified group to create a spider plot which

they utilized to compare the differences of personality patterns between: 1) k-means and Ward's clustering methods for classifying FFS variables, and 2) k-means and Ward's clustering methods for classifying FFV.

For comparison, all four data sets were plotted in two forms (i.e., 5-component spider plots and 44-component spider plots) for a total of eight data sets. The FFS illustrated five computed spider plots. Additionally, the five computed variables were reversed to the original 44 variables and used to create spider plots.

Results and Discussion

Comparison of Cluster Analysis Results Generated from Standardized and Unstandardized Variables

Results indicated that within the same classification method the participants were classified in the same group whether the data were standardized or un-standardized. The classified groups are illustrated in PCA plots (Figures 4.1 and 4.2). The PCA plots of standardized and unstandardized data are almost identical regardless of rotation and distribution of the data points. Baxter (1995) suggests that results obtained by unstandardized and standardized data often will be very similar if no presence of outliers exists. However, in this study the PCA plot of unstandardized data tended to illustrated more distance between each point and does not require the extra step of standardization. Therefore, researchers used unstandardized data for further analyses.

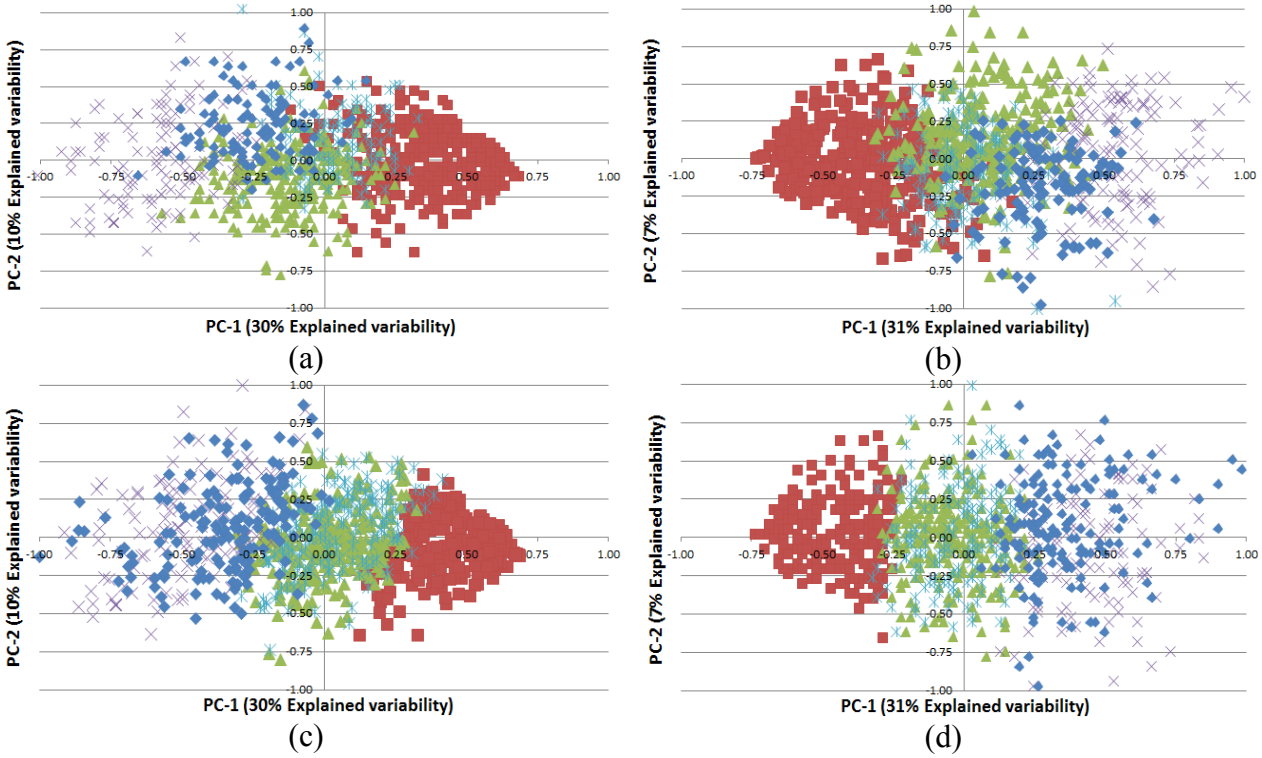


Figure 4.1 **The PC Plots of 44-Personality Items (FFV): (a) Classified Standardized Data by Ward's Clustering Method; (b) Classified Unstandardized Data by Ward's Clustering Method; (c) Classified Standardized Data by K-Means Clustering Method; (d) Classified Unstandardized Data by K-Means Clustering Method**

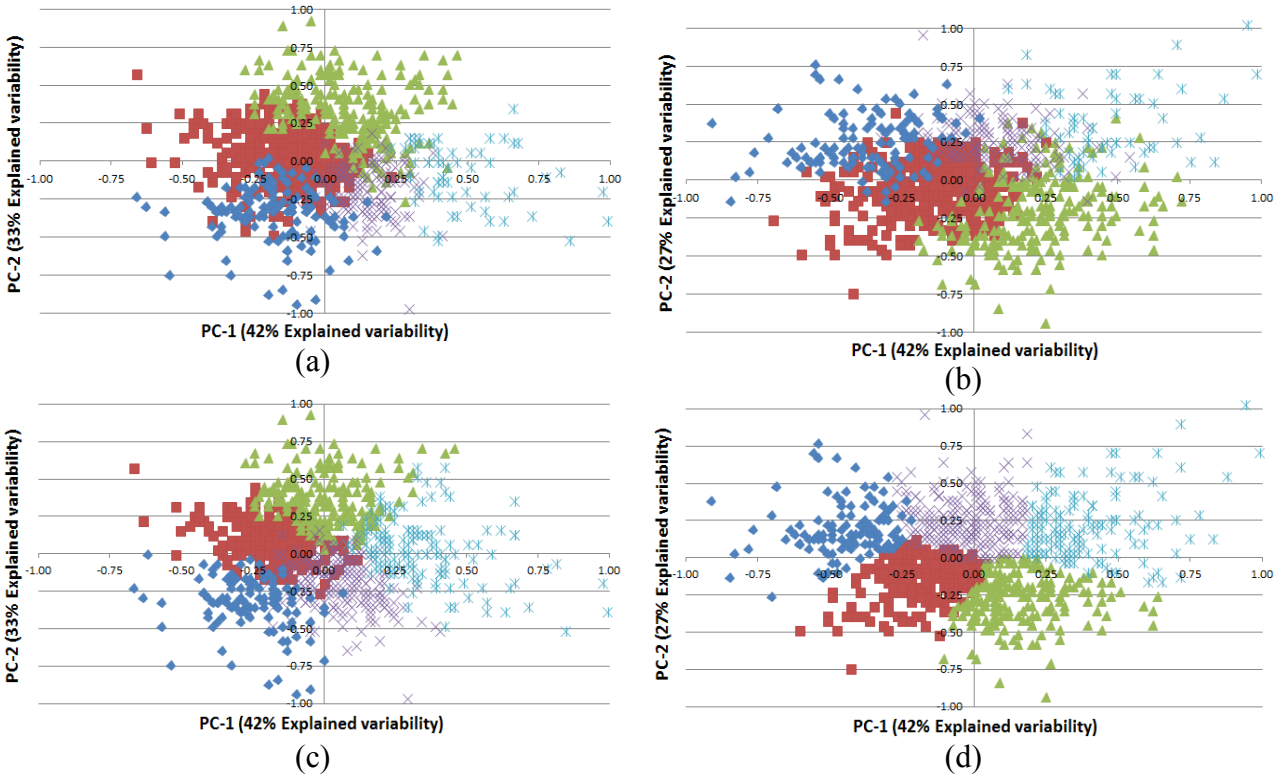


Figure 4.2 **The PC Plots of Five-Personality Items (FFS): (a) Classified Standardized Data by Ward's Clustering Method; (b) Classified Unstandardized Data by Ward's Clustering Method; (c) Classified Standardized Data by K-Means Clustering Method; (d) Classified Unstandardized Data by K-Means Clustering Method**

Comparison of Clustering Methods for Personality Segmentation

Results from the PCA maps indicated that using the 44 variables for participant personality classifications tended to make distinguishing groups of participants difficult because the classified groups overlapped (Figure 4.1). However, because FFV provides high variability, using only the first two principal components (PC) probably is not enough to capture participant variability (≤40% variability explained by the first two PCs). In contrast, the PCA plots for FFS provided better visual aids for discriminating personality groups among participants (Figure 4.2).

The first two PCs explained variability are 74% (unstandardized data) and 69% (standardized data).

In general, K-means clustering method provides better results than Ward's hierarchical clustering methods, or other clustering methods, when used to classify a large data set (Jain, Murty, & Flynn, 1999; Kuo, Ho, & Hu, 2002). However, the classification results vary based on the initial seeds (Jain et al., 1999; Kuo et al., 2002). Prior to clustering with the K-means method, most researchers use the integration of a hierarchical clustering method (e.g., Ward's clustering method) to determine initial information (Punj & Steward, 1983; Kuo et al., 2002; Kleijnen et al. 2004). Consequently, the classifications made by K-means clustering methods tended to discriminate personality patterns better than the classifications made by Ward's clustering methods (Figure 4.2). PC maps for FFS clearly differentiated the personality patterns for each group (Figure 4.2).

Comparison of Cluster Analysis Results Generated from FFV and FFS

Ward's and K-means clustering methods provided similar results for classifying FFS. Both methods segmented personality into five almost identical patterns (Figures 4.3 and 4.4). The spider plots created from FFS illustrated certain similarities between groups 1 and 2, and varying similarities among groups 3, 4, and 5. However, when researchers plotted the 44 variables in spider plots, the five classified groups (results from both Ward's and K-means) appeared slightly different from each other. Therefore, the five computed spider plots did not provide a visual plot that differentiated as well as the 44 original variables.

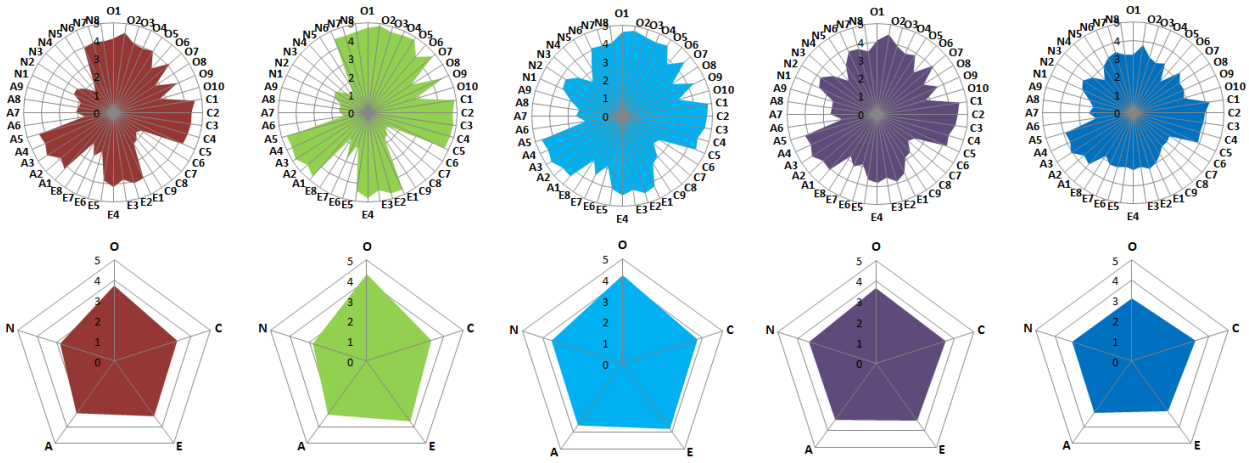


Figure 4.3 **Personality Patterns of Five Computed Variables Classified by Ward's Clustering Method Illustrated Using Spider Plots of Five Computed Variables and Plots of Five Computed Variables Reversed to Original 44 Variables**

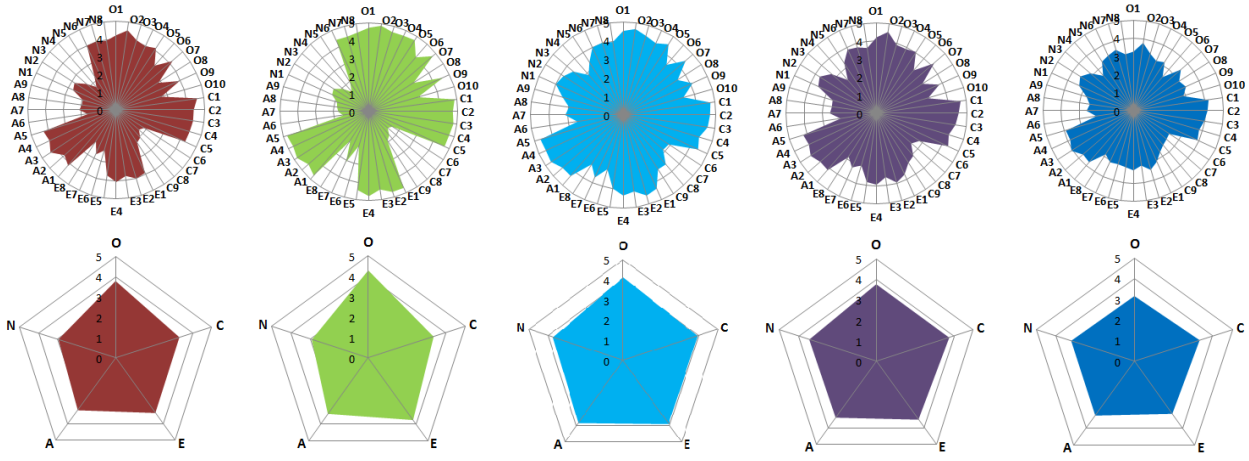


Figure 4.4 **Personality Patterns of Five Computed Variables Classified by K-Means Clustering Method Illustrated Using Spider Plots of Five Computed Variables and Plots of Five Computed Variables Reversed to Original 44 Variables**

Researchers found a notable difference between both classification methods when using FFV in cluster analysis; group 4 from Ward's and k-means clustering methods was different in level of personality scores. Group 4 classified by Ward's clustering method tended to have a higher level of each personality item than group 4 classified by the k-means clustering method.

Using FFV for personality classification provided clear personality group differences for both clustering methods (Figure 4.5 and 4.6). The visual differentiation among groups using all 44 variables to classify personality groups is much greater in Fig 4.5 and 4.6 than in Fig. 4.3 and 4.4 suggesting that using only the five calculated scores results in a compression of the data and less ability to classify consumers into distinct personality groups. Thus, classifications made using FFV to segment personality patterns provided more distinctive classification groups than the classifications made using FFS.

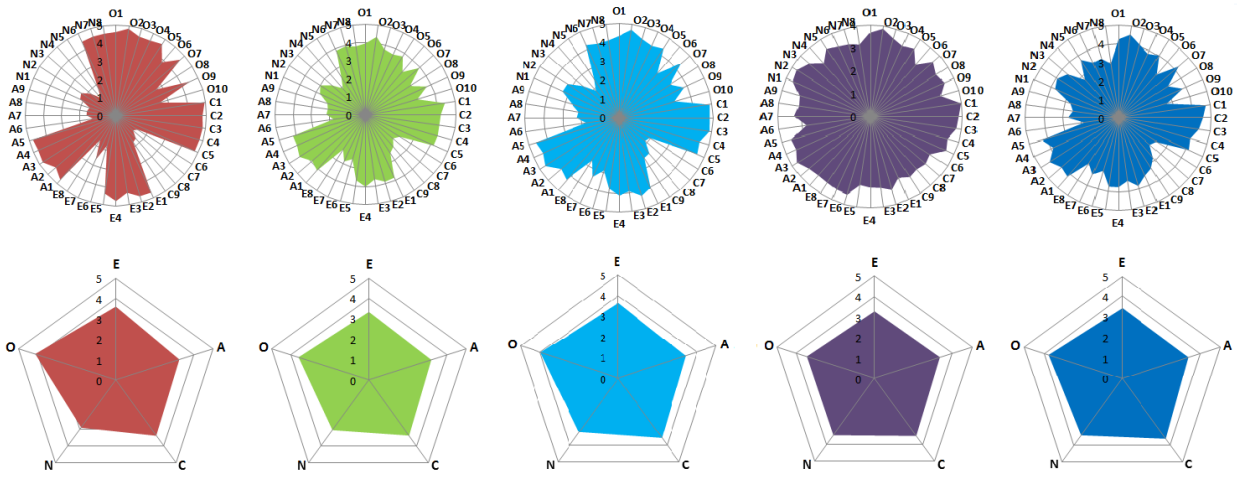


Figure 4.5 **Personality Patterns of 44 Variables Classified by Ward's Clustering Method Illustrated Using Spider Plots of Original 44 Variables and Plots of Transformed Five Computed Variables**

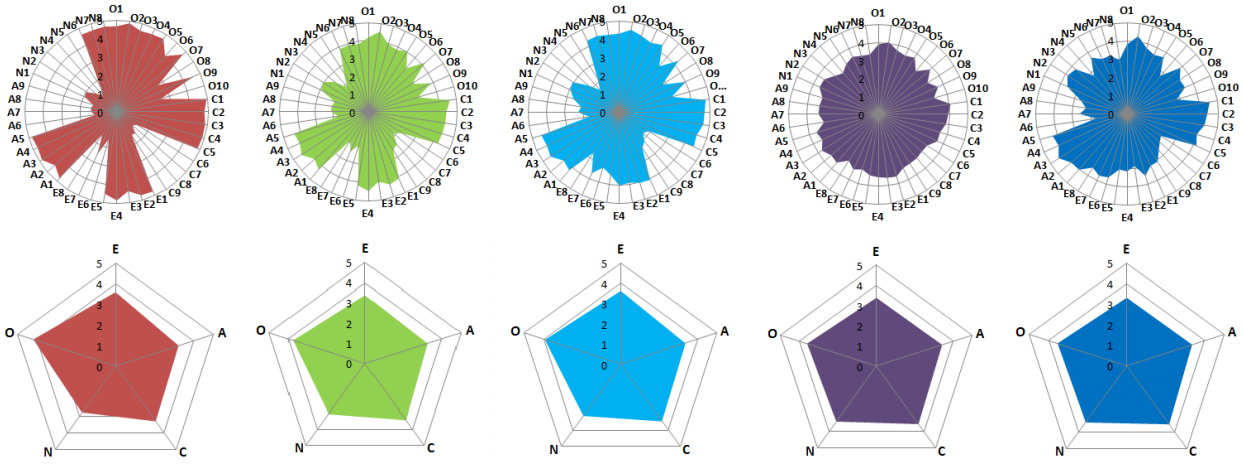


Figure 4.6 **Personality Patterns of 44 Variables Classified by K-Means Clustering Method Illustrated Using Spider Plots of Original 44 Variables and Plots of Transformed Five Computed Variables**

Personality Pattern of Participants

The analysis indicated the five classified personality patterns were significantly different in all 44 statements. Openness to experience responses were rated to be moderate-high across participants from the 5 personality patterns. On the other hand, Extroversion, Agreeableness, and Neuroticism were the dimensions that mainly distinguished the 5 personality patterns from each other due to the larger range of ratings (difference was < 2 points from a 5-point scale). The five personality profiles are illustrated (Supplementary Table 4.1) and described below.

Personality pattern 1 (Extreme personality: very open, responsible, extroverted, agreeable, and emotionally stable): these participants characterized themselves to be extreme in most of 44 statements. Participants perceived themselves to be creative, artistic, responsible, and reliable, and tended to be energetic and talkative; however, they can be reserved and shy. They also tended to be kind and considerate, and they seemed to be calm in most situations.

Personality pattern 2 (Slightly extreme personality: very open, extroverted, and agreeable): participants characterized themselves to be similar to participants from personality pattern 1. However, the statements associated with personality traits were rated slightly lower than participants from pattern 1. Participants from this group rated themselves to be high in extroversion and agreeableness.

Personality pattern 3 (Slightly extreme personality and neurotic): participants evaluated themselves with statements associated with personality traits similar to participants from personality pattern 2; however, in general they were more responsible. Also, they were slightly emotionally unstable (neurotic).

Personality pattern 4 (Emotionally ambivalent): participants evaluated themselves with statements associated with personality traits to be moderate in all 44 statements. Clearly this group did not see themselves as extreme in any particular personality trait across any of the five personality dimensions.

Personality pattern 5 (Emotionally ambivalent and neurotic): In general, participants claimed to be somewhat open to experiences, conscientious, extroverted, and agreeable. The participants from this group were the most emotionally unstable (neurotic) as compared to the other groups.

Conclusions

Results indicated that data standardization is not necessary when the data was conducted using a single scale type. Maps created from the five computed personality items gave a higher percentage explained and visually separated the groups in two dimensions. However, information apparently was lost when compared to the 44 personality items clustering because those clusters were more obviously different from each other than clusters of consumers

determined using only the five computed variables. In part, perhaps because of the large data set, the K-means clustering method appeared to provide a better classification than Ward's clustering method. This selected classification procedure provided a total of 5 personality patterns that could be sued in future product research with consumers.

References

Baxter, M. J. (1995). Standardization and transformation in principal component analysis, with applications to archaeometry. *Journal of the Royal Statistical Society Series A*. *44*(4), 513-527.

Benet-Martínez, V., & John, O. P. (1998). Los cinco grandes across cultures and ethnic groups: Multitrait method analyses of the Big Five in Spanish and English. *Journal of Personality and Social Psychology, 75*, 729-750.

Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Florida: Psychological Assessment Resources.

Goldberg, L. R. (1990). An alternative "description of personality": The Big-Five factor structure. *Journal of Personality and Social Psychology, 59*, 1216-1229.

Harris, J. A., & Lucia, A. (2003). The relationship between self-report mood and personality. *Personality and Individual Differences, 35*, 1903-1909.

Holden, R. R., & Troister, T. (2009). Developments in the self-report assessment of personality and psychopathology in adults. *Canadian Journal of Experimental Psychology, 50*(30), 120-130.

Jain, A. K., Murty, M. N., & Flynn, P. J. (1999). Data clustering: A review**.** *Association for Computing Machinery Computing Survey, 31*(3), 264-323.

Johnson, D. E. (1998). *Applied Multivariate Methods for Data Analysts*. Belmont, CA: Duxbury Press.

Kleijnen, M., Ko, D. R., & Martin, W. (2004). Consumer adoption of wireless services: Discovering the rules, while playing the game. *Journal of Interactive Marketing, 18*(2), 51-61.

Kuo, R. J., Ho, L. M., & Hu, C. M. (2002). Integration of self-organizing feature map and K-means algorithm for market segmentation. *Computer and Operations Research*, *29*(11), 1475-1493.

McCrae, R. R., & Costa, P. T., JR (1999). A Five-factor theory of personality. In L. A. Pervin, & O. P. John (Eds.), *Handbook of Personality: Theory and Research* (2nd ed.) (pp. 139-153). New York: Guilford press.

O'Malley, M. N., & Gillette, C. S. (1984). Exploring the relations between traits and emotions. *Journal of Personality, 52*(3), 274–284.

Punj, G., & Stewart, D. W. (1983). Cluster analysis in marketing research: Review and suggestions for application. *Journal of Marketing Research, 20*(2), 134-148.

Rétiveau, A. N. (2004). *Individual Differences and the Perception of Complex Scents*. Doctoral dissertation, Kansas State University, Manhattan, KS.

Revelle, W., & Scherer, K. R. (2009). Personality and emotion. In D. Sander, & K. R. Scherer (Eds.), *Oxford Companion to Emotion and the Affective Sciences* (pp. 21–28). Oxford, United Kingdom: Oxford University Press.

Ritter, P., Lorig, K., Laurent, D., & Matthews, K. (2004). Internet versus mailed questionnaires: A randomized comparison. *Journal of Medical Internet Research, 6*, 29. doi: 10.2196/jmir.6.3.e29

Salgado, J. F. (2003). Predicting job performance using FFM and non-FFM personality measures. *Journal of Occupational and Organizational Psychology, 76*, 323-346.

Salgado, J. F., & Moscoso, S. (2003). Internet-based personality testing: equivalence of measures and assesses' perceptions and reactions. *International Journal of Selection and Assessment, 11*(2), 194-205.

Schmitt, D. P., Allik, J., Mccrae, R. R., & Benet-Martínez, V. (2007). The geographic distribution of Big Five personality traits: Patterns and profiles of human self-description across 56 nations. *Journal of Cross-Cultural Psychology, 38,* 171. doi: 10.1177/0022022106297299

Wansink, B., Steven, T., & Sonka, S. P. (2004). Segmentation approaches that differentiate consumption frequency from sensory preference. *Journal of Sensory Studies, 19*, 327-340.

Yenket R., Chambers, E. IV, & Johnson, D. E. (2011). Statistical package clustering may not be best for grouping consumers to understand their most liked products. *Journal of Sensory Studies, 26*, 209-225.

Supplementary Results for Chapter 4

Supplementary Table 4.1 Average Response of Participants from Five Classified Personality Patterns on Big-Five Inventory Questionnaire

Personality Trait	Pattern*					Difference (Max-Min)
	1	2	3	4	5	
Openness to Experience:						
O1: Has an active imagination	**4.77** [a]	4.19 [b]	4.32 [b]	3.79 [c]	*3.70* [c]	1.07
O2: Is curious about many different things	**4.94** [a]	4.56 [b]	4.57 [b]	*3.84* [d]	4.20 [c]	1.10
O3: Is ingenious, deep thinker	**4.77** [a]	4.02 [b]	4.34 [b]	3.65 [c]	*3.63* [c]	1.13
O4: Is inventive	**4.83** [a]	3.91 [b]	4.11 [b]	*3.49* [c]	3.50 [c]	1.34
O5: Is original, has new ideas	**4.91** [a]	4.12 [b]	4.28 [b]	*3.60* [c]	3.60 [c]	1.31
O6: Is sophisticated in art, music or literature	**4.45** [a]	3.28 [b]	3.21 [b]	3.12 [b]	*2.62* [c]	1.83
O7: Likes to reflect, play with ideas	**4.91** [a]	4.23 [b]	4.21 [b]	*3.60* [c]	3.67 [c]	1.31
O8: Prefers work that is routine	*2.26* [d]	3.00 [bc]	2.72 [c]	3.21 [b]	**3.63** [a]	1.38
O9: Values artistic, aesthetic experiences	**4.72** [a]	3.84 [b]	3.96 [b]	3.40 [c]	*3.25* [c]	1.47
O10: Has few artistic interests (R)	**4.06** [a]	3.19 [b]	*2.96* [b]	2.98 [b]	3.17 [b]	1.11
Conscientiousness:						
C1: Is a reliable worker	**4.98** [a]	4.63 [bc]	4.85 [ab]	*3.93* [d]	4.53 [c]	1.05
C2: Does a thorough job	**4.94** [a]	4.47 [bc]	4.66 [b]	*3.74* [d]	4.35 [c]	1.19
C3: Does things efficiently	**4.96** [a]	4.40 [bc]	4.64 [b]	*3.72* [d]	4.28 [c]	1.24
C4: Makes plans, follows through with them	**4.98** [a]	4.42 [b]	4.43 [b]	*3.49* [d]	3.95 [c]	1.49
C5: Preserves until the task is finished	**4.94** [a]	4.47 [b]	4.47 [b]	*3.51* [d]	4.15 [c]	1.42
C6: Tends to be disorganized (R)	**4.83** [c]	3.95 [b]	4.06 [b]	*2.74* [a]	3.85 [b]	**2.09***
C7: Tends to be lazy (R)	**4.98** [d]	4.05 [c]	4.17 [c]	*3.09* [a]	3.50 [b]	1.89
C8: Can be somewhat careless (R)	**4.64** [d]	3.51 [b]	3.89 [c]	*2.72* [a]	3.48 [b]	1.92
C9: Is easily distracted (R)	**4.68** [c]	3.58 [b]	3.57 [b]	*2.67* [a]	2.92 [a]	**2.01***
Extraversion:						
E1: Is full of energy	**4.91** [a]	4.19 [b]	4.09 [b]	3.00 [c]	*2.88* [c]	**2.03***
E2: Generates a lot of enthusiasm	**4.96** [a]	4.23 [b]	3.89 [c]	3.60 [cd]	*3.35* [d]	1.61
E3: Has an assertive personality	**4.47** [a]	3.86 [b]	3.62 [b]	3.63 [b]	*2.77* [c]	1.70
E4: Is outgoing, sociable	**4.91** [a]	4.33 [b]	3.94 [c]	3.30 [d]	*3.00* [d]	1.91

Supplementary Table 4.1 (Cont.)

Personality Trait	Pattern*					Difference (Max-Min)
	1	2	3	4	5	
E5: Is talkative	**4.60** [a]	4.00 [b]	3.40 [c]	3.35 [c]	*2.80* [d]	1.80
E6: Tends to be quiet (R)	**4.53** [a]	4.19 [b]	2.98 [c]	2.95 [c]	*2.22* [d]	2.32*
E7: Is reserved (R)	**3.64** [a]	3.56 [a]	2.51 [bc]	2.74 [b]	*2.17* [c]	1.47
E8: Is shy, inhibited (R)	**4.77** [a]	4.05 [b]	3.28 [c]	2.98 [c]	*2.35* [d]	2.42*
Agreeableness:						
A1: Likes to cooperate with others	**4.83** [a]	4.33 [b]	4.17 [bc]	*3.42* [d]	3.98 [c]	1.41
A2: Has a forgiving nature	**4.70** [a]	4.07 [b]	4.11 [b]	*3.37* [c]	3.88 [b]	1.33
A3: Is considerate and kind to almost everyone	**4.98** [a]	4.53 [b]	4.57 [b]	*3.58* [c]	4.47 [b]	1.40
A4: Is generally trusting	**4.87** [a]	4.53 [b]	4.43 [b]	*3.19* [d]	4.08 [c]	1.69
A5: Is helpful and unselfish with others	**4.94** [a]	4.42 [b]	4.43 [b]	*3.42* [d]	4.13 [c]	1.52
A6: Starts quarrels with others (R)	**4.98** [a]	4.19 [c]	4.45 [b]	*2.86* [d]	4.27 [bc]	2.12*
A7: Tends to find fault in others (R)	**4.83** [a]	3.98 [b]	3.60 [c]	*2.84* [d]	3.32 [c]	1.99
A8: Is sometimes rude to others (R)	**4.83** [a]	3.84 [b]	3.96 [b]	*2.58* [c]	3.72 [b]	2.25*
A9: Can be cold and aloof (R)	**4.83** [a]	4.07 [b]	3.40 [c]	*2.58* [d]	3.32 [c]	2.25*
Neuroticism:						
N1: Can be moody	*1.45* [d]	2.88 [c]	3.17 [bc]	**3.74** [a]	3.40 [ab]	2.30*
N2: Can be tense	*1.49 c*	3.14 [b]	2.89 [b]	3.65 [a]	**3.92** [a]	2.43*
N3: Gets nervous easily	*1.28* [d]	2.51 [c]	2.26 [c]	3.21 [b]	**3.90** [a]	2.62*
N4: Is depressed, blue	*1.06* [d]	1.77 [c]	1.62 [c]	**3.16** [a]	2.73 [b]	2.10*
N5: Worries a lot	*1.30* [d]	2.42 [c]	2.28 [c]	3.26 [b]	**3.63** [a]	2.34*
N6: Remains calm in tense situations (R)	*1.17 c*	2.05 [b]	1.83 [b]	2.63 [a]	**2.80** [a]	1.63
N7: Is emotionally stable, not easily upset (R)	*1.19* [d]	2.09 [b]	1.62 [c]	2.70 [a]	**2.68** [a]	1.51
N8: Is relaxed, handles stress well (R)	*1.11* [d]	2.14 [b]	1.83 [c]	2.74 [a]	**3.03** [a]	1.93

* The numbers listed as **Bold** were the highest ratings where the number listed as *Italic* and underlined were the minimum value across the 5 personality clusters. The difference between maximum and minimum were collected and presented in the Table.

** The personality ratings were evaluated using a 5-point Likert scale where 1 = strongly disagree, and 5 = strongly agree. Least square means with the same letter within a row are not significantly different at α = 0.05 as determined by multiple t-tests for least significant difference (LSD) mean separation test.

*** The (R) listed after personality statements represented the negative statements prior to converting for data analysis.

SECTION 2: CONSUMER SEGMENTATIONS AND UNDERSTANDING CONSUMERS' OLFACTORY RESPONSES

Chapter 5 - Effect of Demographic Characteristics on Olfactory Responses to Masculine Fragrances

Abstract

Demographic characteristics (i.e., age and gender) have an impact on liking and fragrance usage. Commercially available fragrances are made and targeted to specific populations (e.g., masculine, feminine, unisex, teenage, etc.). Scientists primarily conduct fragrance research by focusing on how those demographic characteristics affect physiological and psychological responses, i.e., preference and emotions. However, the study of how demographic factors affected thoughts, perceptions, and expectation of individuals (e.g., whether the scents are congruent with a product and the expectation of functional benefits) has not been investigated. In order to understand the influence of demographic characteristics on olfactory induced product expectations, this research investigate the influence of (1) age and (2) gender on responses to olfactory stimuli in regards to liking, emotion, perceptions, attitudes, and expectation of individuals.

Results indicated that age and gender differences did not affect liking, emotion, attitudes, and expectations of individuals toward the same odorant. However, personal differences influenced how individuals used the scales. Age had less effect on scale responses than did gender. These findings show that age and gender were not particularly influential factors on liking or other responses related to odor perception. Thus, simple demographic segmentation may not be an appropriate for consumer segmentation in fragrance research.

Introduction

Understanding how individuals decide selection or consumption of a product has been widely investigated and developed within food choice and consumption concepts (Furnham & Heaven, 1999; Pettinger, Holdsworth, & Gerber 2004; Eertmans, Victoir, Vansant, & Bergh, 2005). Scientists understand the selection process as a complex process that is related to product orientation and can be categorized into two main categories: (a) the intrinsic product characteristics (e.g., a sensory profile of a product) or (b) extrinsic variables (e.g., a person's attributes, such as cognitive information and other personal factors) (Shepherd & Sparks, 1994; Eertmans et al., 2005).

Demographic characteristics consist of individual demographics (e.g., age, gender, ethnicity, education level, and income), psychological and physiological characteristics (i.e., personality traits, moods, emotions, attitudes, and behaviors) (Rétiveau, 2004; Eertmans et al., 2005; Honkanen, Olsen, & Myrland, 2006), social class, household information (e.g., number and age of children, marital status, etc.), as well as location and other geographical aspects (Dommeyer & Gross, 2003; Franks, Lubetkin, & Melnikow, 2007; Honkanen et al., 2006; Rentfrow, Goldberg, & Zilca, 2011; Pescud, Pettigrew, Donovan, Cowie, & Fielder, 2012).

In most cases, demographics and psychological factors are applied in consumer research involving consumer segmentation (Wedel & Kamakura, 1998; Honkanen et al., 2006). Consumer similarity within the same group or consumer dissimilarities across groups can be used for interpreting and explaining variables, e.g., individual sensory perceptions, preference, and acceptance (Furst, Connors, Bisogni, Sobal, & Falk, 1996; Pettinger et al., 2004; Rétiveau, 2004; Eertmans et al., 2005) of products, prices, and promotion (Beane & Ennis, 1987; Dickson & Ginter, 1987; Tynan & Drayton, 1987; Wind, 1978; Funk & Phillips, 1990; Gehrt, 1999; Franks et al., 2007; Honkanen et al., 2006; Rentfrow et al., 2011).

According to Honkanen et al. (2006), demographic segmentation emerges as the most prevalent criteria for consumer segmentation, which is suitable for a specific product category/market study. Results obtained from demographic segmentation are easy to understand and interpret (FitzGerald & Arnott, 1996). In fragrance research, for example, age, and gender are important factors for motivations in fragrance use, as well as preference (Bain, 1997; Graham, 2000; Rétiveau, 2004). In addition, research clearly shows that women indicate higher interest in scents than men (Herz & Cahill, 1997; Herz & Inzlicht, 2002; Herz, 2004).

Most fragrance research has focused on emotional effects and preference of odors (Rétiveau, 2004; Gilbert, 2008; Donna, 2009; Zarzo, 2007; Lindqvist, 2012a; Lindqvist, 2012b; Gleason-Allured, 2010). In addition, research also has shown how individuals associate terms and odor descriptors with fragrances (Rétiveau, 2004; Jellinek 1992; Zarzo & Stanton 2009; Donna 2009; Lindqvist, 2012a; Lindqvist, 2012b) and how scents impact perceptions regarding physiological and psychological effects (Jellinek 1951; Jellinek 1997; Zarzo & Stanton 2009), and occasional usage (Rétiveau, 2004). However, no research was found on how scent impacts the expectation of product performance as related to functional benefits, nor is there a study related to the olfactory congruency with personal care products, which is primarily driven by the presence of scents.

Numerous studies widely cover the effect of demographic characteristics on a person's consumption decision for both fragrance preference and consumption usage (e.g., Lindqvist, 2012a & 2012b). However, studies of how demographic factors affect individuals' thoughts and perceptions (e.g., product congruency, expectation of functional benefits, and term association with odorants) were not found. Thus, the objectives of this study were to investigate the

influence of (1) age and (2) gender on responses regarding individual preference, perception, and functional expectation of fragrances.

Materials and Methods

Participants

A total of 300 participants were selected from 976 males and females across the United States (US) who completed a personality survey. Male participants were individuals who use cologne, fragrance, or fragranced personal care products (e.g., deodorants, shave gel/cream, shave balm, body wash, etc.) and female participants were individuals who liked the smell of cologne, fragrance, or personal care products on men or find themselves attracted to a person who uses these products. A screening survey (Appendix A) and the big-five inventory for personality classification (Appendix B) were used in participant selection.

Researchers divided participants into subcategories based on demographic information: gender and age group (18-25, 26-35, and 36-49). Fifty participants from each sub-demographic (2 genders x 3 age groups) were randomly selected to participate in this study.

Odorant Selection

To reduce the variability of the gender association category of fragrance, this study focused only on "masculine" odorants. Odorant samples were selected from a pool of odorants used for male personal care products. Researchers selected four representative odorant samples and one commercially available cologne for this study. The samples had olfactory characteristics that smelled different from each other. Additionally, each sample had diverse characteristics that covered at least 2-3 subfamilies in Edwards' fragrance wheel (Edwards, 2008) (Table 5.1).

Table 5.1 Selected Odorant Samples and Their Class and Description

Odorant type	Sample	Edwards' classification	Description
Odorant made for male personal care product	112	Mossy woods - Citrus	Chypre: moss, citrus, floral, woody
	357	Soft floral - Green	Soapy, vanilla, musk, rose
	413	Floral-Citrus	Lime, violet
	958	Oriental-Floral	Lavender, coconut, anise, musk
Commercial cologne	504	Aromatic	Fougère: geranium, cedar, lime, musk

Sample Preparation

Throughout the study all odorant bottles were stored at room temperature. Scientists transferred a 0.5 mL sample of each odorant onto a cotton swab (Qtips®, Uniliver, USA) using a disposable 1 mL tuberculin syringe (sterilized) (Fisher Scientific Inc., PA). The cotton swaps were pre-cut in half, length wise (4 cm). The scented cotton swab was placed with the swab side down in an evaluation container and labeled with a 3-digit code. The type of container used in this study was an amber vial screw-thread bottle with a black screw-top cap and a white liner (3.7 mL) (Fisher Scientific Inc., PA). Each container was tightly closed immediately after the scented swab was inserted.

Researchers packed all samples individually in a clear bubble bag with a lip and tape (3.5x4 in) (Staple®, USA) to protect from damage. Once each sample was packed in a bag, a label having a letter "A" was placed onto a bag to represent the first sample for evaluation. The other labels (B, C, D, and E), representing evaluation order from 2^{nd} to 5^{th}, were placed on samples by the assigned presentation order according to the William-modified Latin square design (Meilgaard, Civile, & Carr, 2007). All five samples were packed in a postage box and sent to participants using the United States Postal Office (USPS). The sample set was assumed to arrive at the destination within 1-3 business days.

The test was conducted when the average temperature across country was at the range of 42-56 °F (National Oceanic and Atmospheric Administration [NCDC], 2012). This information provided assurance that the fragrance samples had not deteriorated during transport.

Internet Survey

Prior to the sample shipment, researchers sent an email to target consumers informing them about their qualification. After the samples were shipped each participant received another email notifying them about the package they were to receive and provided the test schedule for 5 odorant samples. The test schedule indicated the dates to complete each sample. The participants were asked to evaluate a sample anytime within the 3 days allotted to each sample at their home. They were asked to evaluate each additional sample in the following 3 day periods. The online-survey for each sample was available only on the specified dates. The participants could not revisit the survey, and they were not allowed to do a make-up test if missed. The test was available for 2 weeks for participants to complete. On the evaluation days, participants were asked to log in to the website and enter the 3-digit sample code appearing on the label of the sample vial to access the survey.

Questionnaires

Within each survey, the participants were asked to complete 6 sets of questions (Appendix *C)*. They were asked to evaluate their current emotions prior to sample evaluation. Then they were asked to sniff a sample and indicate how much they liked the odor. They were asked to re-evaluate their emotions after they had smelled the sample. The survey continued by asking participants to indicate the degree of term association toward an odorant sample as well as their agreement/disagreement on statements on use occasion, potential application in personal

care products, and expectation of functional benefits. The survey took about 20-30 minutes to complete, depending on personal speed.

Emotion Questions and Modification

The ScentMove™ Questionnaire (Porcherot et al., 2010) was used for measuring participant emotion. Participants rated the pertinence of each of the six series of three feeling terms to describe their feelings before and right after smelling the odorant on a 10-cm linear scale, ranging from "no feelings" to "very intense feelings". To maximize the scale, researchers translated the participants' ratings to numeric values from 0 to 100.

Odorant Acceptance

For the hedonic response, participants were asked to indicate how much they liked or disliked each odorant sample's smell on a 9-point scale, where 1 = dislike extremely, to 9 = like extremely.

Degree of Sensory and Consumer Terms Associated with an Odorant

A checklist consisting of an odor strength rating and 16 sensory and consumer terms, modified from previous studies and articles (Jellinek, 1992; Higuchi, Shoji, & Hatayama, 2004; Gleason-Allured, 2008; Zarzo & Stanton, 2009; Falk & Penning, 2012; Lindqvist, 2012a; Porcherot et al., 2012), was used as an evaluation tool to measure sensory associations. Participants were asked to indicate the level of terms associated with an odorant using a numerical scale, ranging from 1 = not at all, to 5 = extreme.

Agreement/Disagreement on Use Occasion

Participants were asked to identify the level of their agreement or disagreement toward 11 different situations on a 5-point Likert scale (1 = strongly disagree, to 5 = strongly agree). The set of given situations consisted of time of day, seasons, activities, and occasions and was

developed and modified from previous studies (Aarts, 2003; Rétiveau, 2004). The question "If you are going to wear this cologne, when would you wear it?" was used to introduce each statement to participants.

Agreement/Disagreement on Potential Application in Personal Care Products

Ten personal care categories, modified from Wormuth, Scheringer, & Hungerbühler (2005), were presented to participants. For each personal care category, participants were asked to indicate how much they agree or disagree on the appropriateness of a particular scent to be included in a particular category on a 5-point Likert scale (1 = disagree strongly to 5 = agree strongly).

Agreement/Disagreement on Expectation of Functional Benefits

To investigate the appropriateness of functional benefits as related to odorants, 17 functional benefits were presented to participants. Participants were asked to determine if they would have expectations of functional benefits from the personal care product each scent they smelled represented A 5-point Likert scale (1 = disagree strongly, to 5 = agree strongly) was provided to participants to indicate their agreement/disagreement on each functional benefit.

Data Analysis

Data Preparation for Emotion Dimensions

Before analyzing the data, researchers subtracted the emotion ratings prior to odorant evaluation from the emotion ratings during the evaluation, to reduce the impact of individuals' initial psychological states (Bhumiratana, 2010; Gibson, 2006).

Demographic Classifications

Two data sets were generated based on participant gender and age, respectively. Researchers analyzed each data set for significant differences of responses, obtained from participants in each subgroup (i.e., male and female, or age 18-25, 26-35, and 36-49).

Analysis of Significant Difference for the Variables of Participants who had Different Demographic Characteristics

Each data set was individually subjected to Analysis of Variance (AOV) using the GLIMMIX procedure at a 5% level of significance (SAS®) performed on the variables. The odorant, demographic group (i.e., age and gender), and interaction of odorant by demographic group were used as fixed effects. Each participant was included in the model as a random effect. Mean separation tests (multiple t-tests') were carried out to determine if significant differences among demographic groups existed.

For each response variable category, the average responses of all five odorant samples, rated by participants from different groups, were illustrated in bar charts with an asterisk (*) representing a significant difference between participant demographics ($p<0.05$).

Results and Discussion

Two hundred forty participants completed the test and provided responses that were not doubtful or obvious faulty entries. Researchers found the demographic distribution of these participants to be similar in the gender category. However, participants were not evenly distributed within the age category; the youngest age group had only 33 participants, whereas, the other two groups had approximately 100 participants *(*Table 5.2)

Table 5.2 Individual Difference Make-Ups of 240 Participants

Age (year)	Female	Male	Total
18-25	12	21	33
26-35	49	52	101
36-49	62	44	106
Total	123	117	240

Effect of Gender Difference on Olfactory Responses

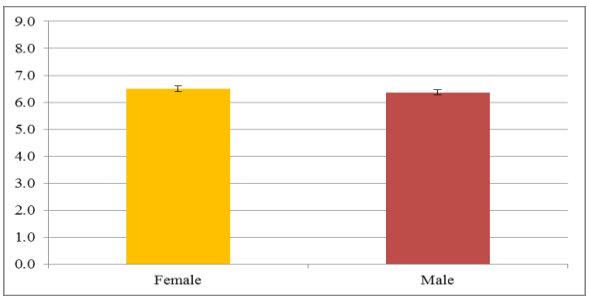
Both female and male participants indicated that all odorants were well-accepted. The analysis showed that both female and male participants had the same olfactory liking toward the same odorants ($p>0.05$) and scored similarly ($p>0.05$) (Supplementary Table 5.1a). Additionally, both gender's participants ($p>0.05$) experienced the same emotion profile at the same intensity ($p>0.05$) (Figure 5.1a). In general, as odorants were presented to participants the participants', *pleasant feeling* and *unpleasant feeling* remained the same, whereas, *refreshment, sensory pleasure,* and *sensuality* increased. The *relaxation* emotion decreased when participants were exposed to these odorants (Figure 5.1b).

Participants from both gender groups similarly associated each of the sensory and consumer terms with the same odorants ($p>0.05$). The test also showed no significant differences between male and female participants on how they associated the terms *masculine* and *feminine* with the same odorants, which was similar to previous research (Zellner, McGarry, Mattern-McClory, & Abreu, 2008). However, female participants associated *masculine* with odorant samples more than male participants ($p<0.05$). In contrast, male participants associated *feminine* with odorants more than female participants ($p<0.05$) (Figure 5.1c) (Supplementary Table 5.1b). This finding conflicted with Lindqvist's (2012b) results that found no significant differences in gender scaling between female and male participants.

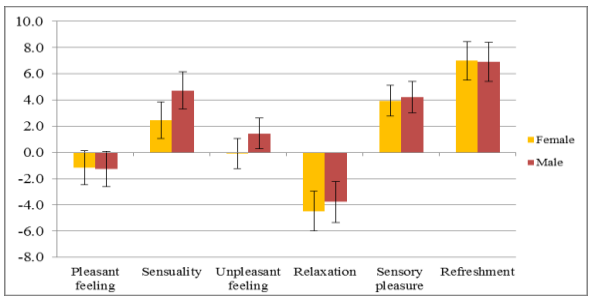
This study's results demonstrated that both female and male participants provided the same score for all use occasions ($p>0.05$) toward the same odorants (Supplementary Table 5.1b). Participants indicated that the odorants were appropriate for most situations except for *sports* and *outdoor* activities, which participants perceived to be less appropriate for the odorants tested (Figure 5.1d). Despite the results demonstrating that men and women had similar perceptions regarding use occasion, female participants scored significantly higher than male participants for fragrance association with *fall* and *winter* seasons ($p<0.05$). This suggests that women tended to use fragrance for inner-directed and emotional motives, whereas, men were more likely to use fragrances for social motives and romance (Rétiveau, 2004).

Both female and male participants indicated similar ratings for each potential application of the same odorant toward each personal care category ($p>0.05$). The odorants were generally rated as being in congruence with most personal care products, except for the sunscreen product (Figure 5.1e). In addition, female participants tended to rate potential application higher than men, especially for the shave gel product ($p<0.05$) (Supplementary Table 5.1c).

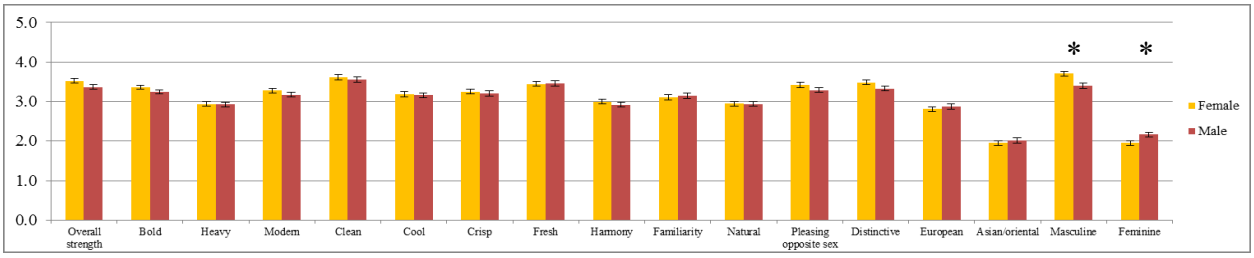
Both women and men had similar expectations of functional benefit when they smelled the same odorants ($p>0.05$) (Supplementary Table 5.1c). Most functional benefits' expectation was rated as moderate-high, except for *heating* property, which was the least expected functional benefit (Figure 5.1e). Again, female participants generally had higher expectations of functional benefits across all products, especially *energizing, refreshing, deep clean,* and *revitalizing,* than did male participants ($p <0.05$).



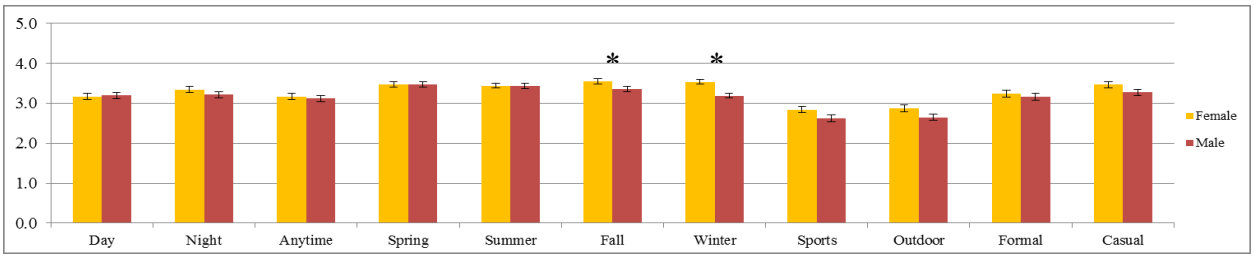
(a)



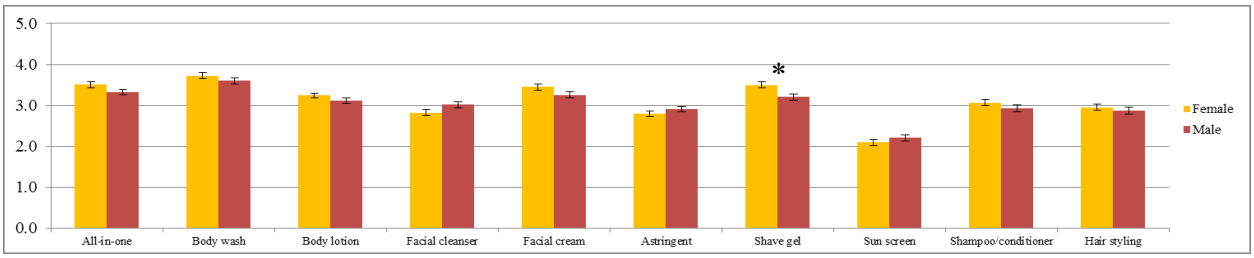
(b)



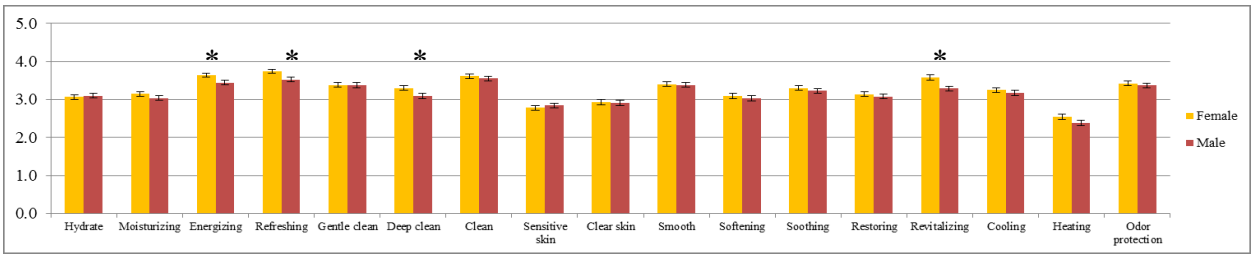
(c)



(d)



(e)



(f)

Figure 5.1 **Average Responses Across Five Odorants Rated by Participants who Had a Different Gender ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application in Personal Care Products, and [f] Expectation of Functional Benefit) (* Represents Significant Difference between Female and Male at $p<0.05$)**

However, women and men had similar olfactory likings and scored their subjective responses similarly toward the same odorants. Results indicate that women tend to score their liking higher than men, which could be explained by Herz's findings related to odor (2004). Herz concluded that women are more favorably predisposed to odors than men because women are attentively interested in scents more so than men. This result can be supported by previous studies indicating that gender influences olfactory performance because women respond higher than men in odor sensitivity (Whisman, Goetzinger, Cotton, & Brinkman, 1978), odor identification and discrimination (Doty et al., 1984), and odor memory (Öberg, Larsson, & Bäckman, 2002; Choudhury, Moberg, & Doty, 2003; Larsson, Lövdén, & Nilson, 2003).

Effect of Age Difference on Olfactory Responses

The analysis results indicates that participants from different age groups liked the same odorants ($p>0.05$) and provided similar responses ($p>0.05$) (Supplementary Table 5.2a). In addition, average olfactory liking scores across all five odorants were higher than 6.0 points on a 9-point scale, which generally indicates that the odorants were well-liked (Figure 5.2a). The similarity of olfactory responses obtained from participants from different age groups indicates that the olfactory liking tends to remain the same (Vroon, Van Amerongen, & de Vries, 1997). Consequently, results obtained from participant age segmentation for fragrance research tended to provide unclear information (Walker, 2012).

The age difference did not affect the emotion experience of participants, as they experienced the same emotion profile when smelling the same odorant (Supplementary Table 5.2a). In general, the presence of odorants increased *sensuality, sensory pleasure,* and *refreshment* emotions. However, *relaxation* decreased after participants smelled the odorants. Odorant exposures did not seem to affect *pleasant* and *unpleasant feelings* as much as they

affected the other emotion sets, as the standard errors covered the positive and negative regions of the chart (Figure 5.2b).

Participants of the three age groups similarly associated each consumer term with the same odorant ($p>0.05$) (Supplementary Table 5.2b) and moderately associated most terms with the odorant samples. Because samples used in this research were masculine cologne/odorants, the terms *masculine* and *clean* were highly associated with these odorants. On the other hand, terms *feminine* and *Asian/oriental* were the least associated with the odorants in this study (Figure 5.2c). This study's finding demonstrates the relationship between *feminine* and *Asian/oriental* is congruent with how commercial feminine fragrances usually consist of oriental and floral scents (Rétiveau, 2004).

Age differences did not influence responses as much as the gender difference, and all participants from different age groups similarly indicated that the odorants were appropriate in most occasions ($p>0.05$) (Figure 5.2d). However, all participants indicated that the odorants were less appropriate in *sports* and *outdoor* activities ($p<0.05$) (Supplementary Table 5.2b).

Participants of all age groups provided the same responses regarding the potential application of the same odorants in each personal care product ($p>0.05$) (Supplementary Table 5.2c). In general, all participants indicated that they perceived all odorants as being congruent with most personal care products (Figure 5.2e). However, the odorants were not congruent with *sunscreen*, which usually is found to have a simple scent or is unfragranced (Hayden 2009).

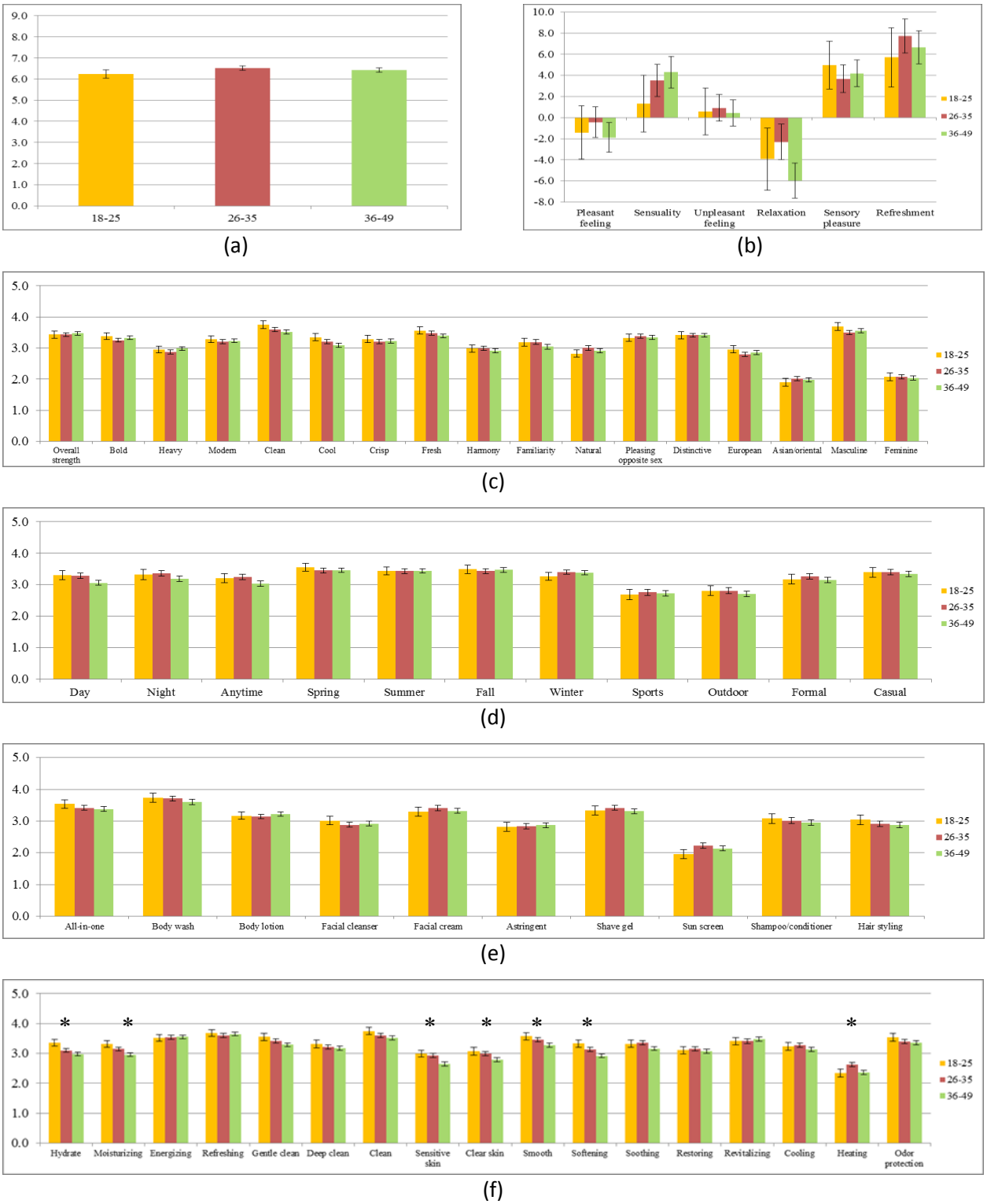


Figure 5.2 **Average Responses Across Five Odorants Rated by Participants who Were Different Age Groups ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application in Personal Care Products, and [f] Expectation of Functional Benefit) (* Represents Significant Difference among 3 Age Groups at $p<0.05$)**

All participants had the same expectations for the functional benefit of each odorant ($p>0.05$) (Supplementary Table 5.2c). However, younger participants had higher expectations than older participants on the same functional benefits (Figure 5.2f). The influence of age difference was more pronounced when participants expected odorants to provide *moisturizing, hydration, sensitive skin, clear skin, smoothing, softening,* and *heating* properties ($p<0.05$). These results could support Walker's (2012) conclusion that age segmentation is used commonly for research in the skin care category but not in fragrance research.

Conclusions

Using demographic segmentation of individuals seems to provide an insufficient explanation for fragrance research. Participants who were different in age or gender experienced the same emotions, had the same olfactory liking toward the same odorant, and similarly associated terms with the same odorant. Similar responses were found for use occasion, product congruency, and expectations of individuals toward the same odorant. These responses also were found to be equivalent despite the difference in age and gender.

Researchers noted a minor impact of demographic differences on responses obtained from participants in this study. The demographic difference affected how individuals used the scale. The age difference was more pronounced in what individuals expected from the functional benefits of the odorants, as younger participants generally had higher expectations than the older participants. Gender difference affected participant responses in that men associated the term *feminine* with odorants more than women, and women associated the term *masculine* with odorants more than men.

References

Aarts, P. (2003). Fragrances with real impact. *Perfumer and Flavorist*, *28*(5), 34-49.

Bain, H. (1997). Why people use perfumes. In P. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp. 232-239). London, Chapman and Hall.

Beane, T. P., & Ennis, D. M. (1987). Market segmentation: A review. *European Journal of Marketing*, *21*(5), 20–42.

Bhumiratana, N. (2010). *The Development of an Emotion Lexicon for the Coffee Drinking Experience* (Doctoral Dissertation). Retrieved from http://krex.k-state.edu/dspace/handle/2097/7010

Choudhury, E. S., Moberg, P., & Doty, R. L. (2003). Influences of age and sex on a microencapsulated odormemory test. *Chemical Senses, 28*, 799–805.

Dickson, P., & Ginter, J. L. (1987). Market segmentation, product differentiation, and marketing strategy. *Journal of Marketing*, *51,* 1–10.

Dommeyer, C. J., & Gross, B. L. (2003). What consumers know and what they do: An investigation of consumer knowledge, awareness, and use of privacy protection strategies. *Journal of Interactive Marketing, 17,* 34–51. doi: 10.1002/dir.10053

Donna, L. (2009, December). Fragrance perception is everything relative? *Perfumer and Flavorist*. *34,* 26-35.

Doty, R. L., Shaman, P., Applebaum, S. L., Giberson, R., Siksorski, L., & Rosenberg, L. (1984). Smell identification ability: Change with age. *Science*, *226*, 1441–1443.

Edwards, M. (2008). *Fragrances of the World: Parfums du Monde 2008* (24th ed.). Fragrances of the World, Sidney.

Eertmans, A., Victoir, A., Vansant, G., & Bergh, O. V. D. (2005). Food-related personality trait, food choice motives and food intake: Mediator and moderator relationship. *Food Quality and Preference*, *16*(8), 714-726.

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from 153230175.html

FitzGerald, M., & Arnott, D. (1996). Understanding demographic effects on marketing communications as services. *International Journal of Service Industry Management*, *7*(3), 31–42.

Franks, P., Lubetkin, E. I., & Melnikow, J. (2007). Do personal and societal preferences differ by socio-demographic group? *Health Economics*, *16,* 319–325. doi: 10.1002/hec.1152

Funk, T. F., & Phillips, W. (1990). Segmentation of the market for table eggs in Ontario. *Agribusiness*, *6*(4), 309–327.

Furnham, A., & Heaven, P. (1999). Personality and consumption. In A. Furnham & P. Heaven (Eds.), *Personality and Social Behavior* (pp. 247-279). London: Arnold.

Furst, T., Connors, M., Bisogni, C. A., Sobal, J., & Falk, L. W. (1996). Food choice: A conceptual model of the process. *Appetite*, *26*(3), 247-265.

Gehrt, K. C. (1999). Situational segmentation opportunities in the snack food market. *Journal of Food Products Marketing*, *5*(4), 1–18.

Gibson, E. L. (2006). Emotional influences on food choice: Sensory, physiological and psychological pathways. *Physiology & Behavior*, *89*(1), 53-61. doi.10.1016/j.physbeh.2006.01.024

Gilbert, A. N. (2008). *What The Nose Knows: The Science of Scent in Everyday Life.* New York: Harper Perennial.

Gleason-Allured, J. (2008, October). Scent world 2008: report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist .com/events/coverage/31286474.html

Gleason-Allured, J. (2010, April). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/ 93719369.html

Graham, J. A. (2000). The psychology of fragrance and aromatherapy. In H. Butler (Ed.), *Poucher's Perfumes, Cosmetics and Soaps* (10th Ed.) (pp. 749-767). Boston: Kluwer Academic.

Hayden, N. (2009, December). Sun care: To scent or not to scent. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/suncare/78699012.html

Herz, R. S. (2004). A comparison of autobiographical memories triggered by olfactory, visual and auditory stimuli. *Chemical Senses, 29,* 217-224.

Herz, R. S., & Cahill, E. D. (1997). Differential use of sensory information in sexual behavior as a function of sex. *Human Nature, 8*, 275–286.

Herz, R. S. & Inzlicht, M. (2002). Sex differences in response to physical and social factors involved in human mate selection: The importance of smell for women. *Evolution and Human Behavior, 23*. 359–364.

Higuchi, T., Shoji, K. and Hatayama, T. (2004), Multidimensional scaling of fragrances: A comparison between the verbal and non-verbal methods of classifying fragrances. *Japanese Psychological Research*, *46* (1), 10–19. doi: 10.1111/j.1468-5884.2004.00232.x

Honkanen, P., Olsen, S. O., & Myrland, Ø. (2006). Preference-based segmentation: A study of meal preferences among Norwegian teenagers. *Journal of Consumer Behaviour*, *3,* 235–250. doi: 10.1002/cb.137

Jellinek, J. S. (1992). Perfume classification: A new approach. In S. Van Toller & G. H. Dodd (Eds.), *Fragrance: The Psychology and Biology of Perfume* (pp. 229–242). London, U.K: Chapman and Hall.

Jellinek, P. (1951). *Die Psychologischen Grundlagen der Parfümerie*. Heidelberg: Alfred Hüthig Verlag.

Jellinek, P. (1997). The psychological basis of perfumery. In J. S. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp.1-162). London: Chapman and Hall.

Larsson, M., Lövdén, M., Nilson, L. G. (2003). Sex differences in recollective experience for olfactory and verbal information. *Acta Psychologica, 112*(1), 89-103.

Lindqvist, A. (2012a). Perfume preferences and how they are related to commercial gender classifications of fragrances. *Chemosensory Perception*, *5*(2), 197-204. doi: 10.1007/s12078-012-9119-7

Lindqvist, A. (2012b). Preference and gender associations of perfumes applied on human skin. *Journal of Sensory Studies*, *27*, 490–497. doi:10.1111/joss.12014

Meilgaard, M., Civile, G. V., & Carr, B. T. (2007). *Sensory Evaluation Techniques (4th ed.)*. Florida, USA: CRC Press.

National Oceanic and Atmospheric Administration. (2012). *National Climatic Data Center (NCDC): The World's Largest Active Archive of Weather and Climate Data Producing and Supplying Data and Publications for the World*. Retrieved from http://www.ncdc.noaa.gov

Öberg, C., Larsson, M., & Bäckman, L. (2002). Differential sex effects in olfactory functioning: The role of verbal processing. *Journal of the International Neuropsychological Society, 8*, 691–698.

Pescud, M., Pettigrew, S., Donovan, R. J., Cowie, S., & Fielder, L. (2012). Australian children's food and drink preferences: Implications for health professionals. *Nutrition & Dietetics*, *69,* 278–284. doi: 10.1111/j.1747-0080.2012.01606.x

Pettinger, C., Holdsworth, M., & Gerber, M. (2004). Psycho-social influences on food choice in southern France and central England. *Appetite*. *42*(3), 307-316.

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. doi: 10.1016/j.foodqual.2011.07.006

Porcherot, C., Delplanque, S., Raviot-Derrien, S., Le Calvé, B., Chrea, C., Gaudreau, N., Cayeux, I. (2010). How do you feel when you smell this? Optimization of a verbal measurement of odor-elicited emotions. *Food Quality and Preference, 21*, 938–947.

Rentfrow, P. J., Goldberg, L. R., & Zilca, R. (2011). Listening, watching, and reading: The structure and correlates of entertainment preferences. *Journal of Personality*, *79,* 223–258. doi: 10.1111/j.1467-6494.2010.00662.x

Rétiveau, A. N. (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRetiveau2004.pdf?sequence=1

Shepherd, R., & Sparks, P. (1994). Modeling food choice. In H. J. H. MacFie & D. M. H. Thomson (Eds.), *Measurement of Food Preferences* (pp. 202-225). Glasgow: Chapman and Hall.

Tynan, A. C., & Drayton, J. (1987). Market segmentation. *Journal of Marketing Management*, *2*(3), 301–335.

Vroon, P., Van Amerongen, A., & de Vries, H. (1997). *Smell: The secret seducer*. New York, Farrar, Straus & Giroux.

Walker, R. (2012, November). A challenging global climate for fragrances. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/176008071.html

Wedel, M., & Kamakura, W. A. (1998). *Market Segmentation: Conceptual and Methodological Foundations*. London, UK: Kluwer Academic Publishers.

Whisman, M. L., Goetzinger, J. W., Cotton, F. O., & Brinkman, D. W. (1978). Odorant evaluation: A study of ethanethiol and tetrahydrothiophene as warning agents in propane. *Environment, Science, & Technology*, *12*, 1285-1288.

Wind, Y. (1978). Issues and advances in segmentation Research. *Journal of Marketing Research*, *15,* 317–337.

Wormuth, M., Scheringer, M., & Hungerbühler, K. (2005), Linking the use of scented consumer products to consumer exposure to polycyclic musk fragrances. *Journal of Industrial Ecology*, *9,* 237–258. doi: 10.1162/1088198054084626

Zarzo, M., & Stanton, D. T. (2009). Understanding the underlying dimensions in perfumers' odor perception space as a basis for developing meaningful odor maps. *Attention, Perception, and Psychophysics*, *71,* 225–247.

Zarzo, M. (2007). The sense of smell: Molecular basis of odorant recognition. *Biological Reviews*, *82,* 455–479.

Zellner, D. A., McGarry, A., Mattern-McClory, R., & Abreu, D. (2008). Masculinity/Femininity of fine fragrances affects color–odor correspondences: A case for cognitions influencing cross-modal correspondences. *Chemical Senses, 33*, 211–222.doi:10.1093/chemse /bjm081

Supplementary Results for Chapter 5

Supplementary Table 5.1a Overall Analysis of Gender Effect on Olfactory Liking Scores and Net Average Emotion Responses across 5 Odorant Samples Rated by 123 Female and 117 Male Consumers

Response		Gender		p-value		
		Female (n=123)	Male (n=117)	Gender	Sample	Interaction
Hedonic	Odorant liking	6.50 ^{ns}	6.37 ^{ns}	0.3678	**<0.0001**	0.4150
Emotion series	*Pleasant feeling*	-1.16 ^{ns}	-1.26 ^{ns}	0.9572	**0.0005**	0.5889
	Sensuality	2.47 ^{ns}	4.71 ^{ns}	0.2572	**0.0008**	0.6154
	Unpleasant feeling	-0.08 ^{ns}	1.44 ^{ns}	0.3599	**<0.0001**	0.7802
	Relaxation	-4.48 ^{ns}	-3.78 ^{ns}	0.7477	**<0.0001**	0.9345
	Sensory pleasure	3.94 ^{ns}	4.23 ^{ns}	0.8614	**0.0586**	0.4939
	Refreshment	6.99 ^{ns}	6.93 ^{ns}	0.9764	**<0.0001**	0.7789

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 5.1b Overall Analysis of Gender Effect on Average Level of Sensory and Consumer Terms Associated with 5 Odorant Samples and Use Occasion Rated by 123 Female and 117 Male Consumers

Response			Gender		p-value		
			Female (n=123)	Male (n=117)	Gender	Sample	Interaction
Sensory and consumer terms	*Overall strength*		3.52 [a]	3.37 [a]	0.0626	**<0.0001**	0.2858
	Bold		3.36 [a]	3.24 [a]	0.1469	**<0.0001**	0.3003
	Heavy		2.94 [a]	2.92 [a]	0.8851	**<0.0001**	0.0797
	Modern		3.28 [a]	3.17 [a]	0.2085	**0.0007**	0.5308
	Clean		3.56 [a]	3.54 [a]	0.7862	**<0.0001**	0.8072
	Cool		3.19 [a]	3.16 [a]	0.7341	**<0.0001**	0.2417
	Crisp		3.25 [a]	3.21 [a]	0.6547	**<0.0001**	0.8005
	Fresh		3.44 [a]	3.46 [a]	0.8403	**<0.0001**	0.8706
	Harmony		3.00 [a]	2.92 [a]	0.3957	**<0.0001**	0.7426
	Familiarity		3.10 [a]	3.15 [a]	0.6304	**0.0088**	0.6748
	Natural		2.94 [a]	2.94 [a]	0.9741	**<0.0001**	0.0515
	Pleasing opposite sex		3.42 [a]	3.29 [a]	0.1401	**0.0030**	0.4580
	Distinctive		3.48 [a]	3.33 [a]	0.0679	0.1809	**0.0409**
	European		2.80 [a]	2.87 [a]	0.4596	0.2072	0.3187
	Asian/Oriental		1.95 [a]	2.01 [a]	0.4983	0.1093	0.0899
	Masculine		3.70 [a]	3.39 [b]	**0.0010**	**<0.0001**	0.7154
	Feminine		1.95 [b]	2.16 [a]	**0.0165**	**<0.0001**	0.0990
Use occasion	Time	Day	3.17 [a]	3.20 [a]	0.7828	**<0.0001**	0.0593
		Night	3.34 [a]	3.21 [a]	0.2708	0.0550	0.2469
		Anytime	3.17 [a]	3.12 [a]	0.6978	**0.0002**	0.3576
	Season	Spring	3.47 [a]	3.47 [a]	0.9694	**<0.0001**	0.3531
		Summer	3.44 [a]	3.43 [a]	0.8710	**<0.0001**	0.5807
		Fall	3.56 [a]	3.35 [b]	**0.0303**	0.0867	0.4887
		Winter	3.54 [a]	3.19 [b]	**0.0002**	**0.0208**	0.7225
	Activity	Sports	2.84 [a]	2.62 [a]	0.0616	**0.0034**	0.5986
		Outdoor	2.87 [a]	2.65 [a]	0.0550	**0.0166**	0.1122
		Formal	3.24 [a]	3.16 [a]	0.4943	**0.0015**	0.5327
		Casual	3.47 [a]	3.27 [a]	0.0879	**0.0004**	0.3002

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 5.1c Overall Analysis of Gender Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits of 5 Odorant Samples Rated by 123 Female and 117 Male Consumers

Response			Gender		p-value		
			Female (n=123)	Male (n=117)	Gender	Sample	Interaction
Personal care	Body care	*All-in-one*	3.50 [a]	3.32 [a]	0.0646	**<0.0001**	0.8315
		Body wash	3.73 [a]	3.60 [a]	0.1652	**<0.0001**	0.8053
		Body lotion	3.24 [a]	3.12 [a]	0.2218	**<0.0001**	0.0982
	Facial care	*Facial cleanser*	2.82 [a]	3.02 [a]	0.0648	**<0.0001**	0.1848
		Facial cream	3.45 [a]	3.25 [a]	0.0546	**0.0146**	0.4457
		Astringent	2.79 [a]	2.91 [a]	0.2848	**0.0004**	0.4980
		Shave gel	3.50 [a]	3.21 [b]	**0.0057**	**0.0009**	**0.0410**
		Sunscreen	2.09 [a]	2.21 [a]	0.3202	**<0.0001**	0.5234
	Hair care	*Shampoo and conditioner*	3.07 [a]	2.93 [a]	0.2098	**<0.0001**	0.4879
		Hair styling	2.95 [a]	2.88 [a]	0.4949	**<0.0001**	0.9592
Functional benefit	*Hydrate*		3.07 [a]	3.10 [a]	0.6938	**<0.0001**	0.5667
	Moisturizing		3.14 [a]	3.04 [a]	0.2066	**<0.0001**	0.3253
	Energizing		3.64 [a]	3.44 [b]	**0.0179**	**<0.0001**	0.9310
	Refreshing		3.74 [a]	3.52 [b]	**0.0088**	**0.0001**	0.9790
	Gentle clean		3.38 [a]	3.38 [a]	0.9458	**<0.0001**	0.4310
	Deep clean		3.31 [a]	3.10 [b]	**0.0311**	**0.1733**	0.1999
	Clean		3.61 [a]	3.56 [a]	0.5110	**<0.0001**	0.9738
	Sensitive skin		2.79 [a]	2.84 [a]	0.6043	**<0.0001**	0.5028
	Clear skin		2.93 [a]	2.90 [a]	0.7606	**<0.0001**	0.9344
	Smooth		3.40 [a]	3.38 [a]	0.8018	**<0.0001**	0.6341
	Softening		3.10 [a]	3.03 [a]	0.5131	**<0.0001**	0.6964
	Soothing		3.30 [a]	3.23 [a]	0.4584	**<0.0001**	0.6300
	Restoring		3.14 [a]	3.08 [a]	0.5104	**0.0025**	0.9235
	Revitalizing		3.58 [a]	3.29 [b]	**0.0009**	**0.0003**	0.8560
	Cooling		3.25 [a]	3.17 [a]	0.3634	**<0.0001**	0.7132
	Heating		2.55 [a]	2.39 [a]	0.0919	0.1812	0.5489
	Odor protection		3.42 [a]	3.37 [a]	0.5549	**0.0054**	0.9375

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 5.2a Overall Analysis of Age Effect on Olfactory Liking Scores and Net Average Emotion Responses across 5 Odorant Samples Rated by Consumers From Different Age Groups

Response		Age Group (year)			p-value		
		18-25 (n=33)	26-35 (n=101)	36-49 (n=106)	Age group	Sample	Interaction
Hedonic	Odorant liking	6.24 [ns]	6.52 [ns]	6.42 [ns]	0.4317	**<0.0001**	0.1018
Emotion series	*Pleasant feeling*	-1.42 [ns]	-0.43 [ns]	-1.89 [ns]	0.7653	**0.0084**	0.1997
	Sensuality	1.31 [ns]	3.53 [ns]	4.30 [ns]	0.6224	**0.0008**	0.6489
	Unpleasant feeling	0.58 [ns]	0.92 [ns]	0.44 [ns]	0.9645	**0.0006**	0.3144
	Relaxation	-3.92 [ns]	-2.30 [ns]	-5.97 [ns]	0.2955	**<0.0001**	0.7307
	Sensory pleasure	4.95 [ns]	3.68 [ns]	4.18 [ns]	0.8832	**0.0134**	0.2853
	Refreshment	5.70 [ns]	7.71 [ns]	6.64 [ns]	0.7955	**<0.0001**	0.1563

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 5.2b Overall Analysis of Age Effect on Average Level of Sensory and Consumer Terms Associated With 5 Odorant Samples and Use Occasion Rated by Consumers from Different Age Groups

Response			Age Group (year)			p-value		
			18-25 (n=33)	18-25 (n=101)	18-25 (n=106)	Age Group	Sample	Interaction
Sensory and consumer term	*Overall strength*		3.43 ^{ns}	3.43 ^{ns}	3.47 ^{ns}	0.8800	**<0.0001**	0.5297
	Bold		3.38 ^{ns}	3.25 ^{ns}	3.33 ^{ns}	0.4689	**<0.0001**	0.2356
	Heavy		2.95 ^{ns}	2.87 ^{ns}	2.98 ^{ns}	0.4443	**<0.0001**	0.4450
	Modern		3.28 ^{ns}	3.20 ^{ns}	3.23 ^{ns}	0.8154	**0.0320**	0.1048
	Clean		3.73 ^{ns}	3.55 ^{ns}	3.50 ^{ns}	0.2321	**0.0002**	0.1219
	Cool		3.35 ^{ns}	3.20 ^{ns}	3.09 ^{ns}	0.1591	**0.0004**	0.7680
	Crisp		3.29 ^{ns}	3.21 ^{ns}	3.22 ^{ns}	0.8555	**0.0017**	0.6004
	Fresh		3.56 ^{ns}	3.48 ^{ns}	3.39 ^{ns}	0.3576	**<0.0001**	0.4726
	Harmony		2.98 ^{ns}	2.99 ^{ns}	2.92 ^{ns}	0.7685	**0.0020**	0.0611
	Familiarity		3.19 ^{ns}	3.19 ^{ns}	3.04 ^{ns}	0.2830	**0.0116**	0.3236
	Natural		2.82 ^{ns}	3.00 ^{ns}	2.92 ^{ns}	0.3941	**0.0003**	0.1709
	Pleasing opposite sex		3.33 ^{ns}	3.38 ^{ns}	3.35 ^{ns}	0.9182	0.1142	0.3656
	Distinctive		3.41 ^{ns}	3.41 ^{ns}	3.41 ^{ns}	0.9987	0.2485	0.2737
	European		2.96 ^{ns}	2.79 ^{ns}	2.85 ^{ns}	0.4799	0.3686	0.2997
	Asian/Oriental		1.90 ^{ns}	2.01 ^{ns}	1.97 ^{ns}	0.7567	0.2573	0.9136
	Masculine		3.69 ^{ns}	3.50 ^{ns}	3.56 ^{ns}	0.4453	**<0.0001**	0.2415
	Feminine		2.07 ^{ns}	2.07 ^{ns}	2.03 ^{ns}	0.9234	**<0.0001**	0.6909
Use occasion	Time	Day	3.30 ^{ns}	3.28 ^{ns}	3.06 ^{ns}	0.1317	**0.0010**	0.1101
		Night	3.32 ^{ns}	3.36 ^{ns}	3.19 ^{ns}	0.3709	0.3897	0.3976
		Anytime	3.21 ^{ns}	3.24 ^{ns}	3.03 ^{ns}	0.1748	**0.0079**	0.2258
	Season	Spring	3.55 ^{ns}	3.45 ^{ns}	3.46 ^{ns}	0.7976	**<0.0001**	0.2574
		Summer	3.44 ^{ns}	3.43 ^{ns}	3.44 ^{ns}	0.9908	**<0.0001**	0.1161
		Fall	3.49 ^{ns}	3.43 ^{ns}	3.47 ^{ns}	0.8976	0.2112	0.1958
		Winter	3.26 ^{ns}	3.40 ^{ns}	3.38 ^{ns}	0.6469	0.2777	0.5580
	Activity	Sports	2.68 ^{ns}	2.76 ^{ns}	2.73 ^{ns}	0.9202	0.0759	0.1749
		Outdoor	2.81 ^{ns}	2.81 ^{ns}	2.70 ^{ns}	0.6592	0.1222	0.2081
		Formal	3.17 ^{ns}	3.27 ^{ns}	3.15 ^{ns}	0.5897	0.1604	0.2890
		Casual	3.39 ^{ns}	3.40 ^{ns}	3.34 ^{ns}	0.8808	**0.0120**	0.3352

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 5.3c Overall Analysis of Age Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits of 5 Odorant Samples Rated by Consumers from Different Age Groups

Response			Age Group (year)			p-value		
			18-25 (n=33)	18-25 (n=101)	18-25 (n=106)	Age Group	Sample	Interaction
Personal care	Body care	*All-in-one*	3.54 ^{ns}	3.42 ^{ns}	3.38 ^{ns}	0.5506	**0.0020**	0.2329
		Body wash	3.73 ^{ns}	3.71 ^{ns}	3.60 ^{ns}	0.3868	**0.0002**	0.1430
		Body lotion	3.17 ^{ns}	3.15 ^{ns}	3.22 ^{ns}	0.8064	**<0.0001**	0.2359
	Facial care	*Facial cleanser*	3.02 ^{ns}	2.88 ^{ns}	2.92 ^{ns}	0.6864	**0.0006**	0.4321
		Facial cream	3.29 ^{ns}	3.41 ^{ns}	3.32 ^{ns}	0.6309	0.3301	0.0906
		Astringent	2.82 ^{ns}	2.84 ^{ns}	2.87 ^{ns}	0.9573	**0.0140**	0.3060
		Shave gel	3.33 ^{ns}	3.42 ^{ns}	3.31 ^{ns}	0.6530	0.0994	0.0795
		Sunscreen	1.96 ^{ns}	2.23 ^{ns}	2.14 ^{ns}	0.3052	**<0.0001**	0.8235
	Hair care	*Shampoo and conditioner*	3.08 ^{ns}	3.02 ^{ns}	2.96 ^{ns}	0.7335	**<0.0001**	0.2697
		Hair styling	3.04 ^{ns}	2.92 ^{ns}	2.87 ^{ns}	0.6421	**<0.0001**	0.6710
Functional benefit	*Hydrate*		3.36 ^{a}	3.10 ^{ab}	2.98 ^{b}	**0.0162**	**<0.0001**	0.3674
	Moisturizing		3.32 ^{a}	3.15 ^{a}	2.96 ^{b}	**0.0131**	**<0.0001**	0.4739
	Energizing		3.52 ^{a}	3.54 ^{a}	3.55 ^{a}	0.9595	**0.0005**	0.4090
	Refreshing		3.68 ^{a}	3.60 ^{a}	3.65 ^{a}	0.7977	**0.0041**	0.3956
	Gentle clean		3.55 ^{a}	3.42 ^{a}	3.29 ^{a}	0.1224	**<0.0001**	0.3944
	Deep clean		3.32 ^{a}	3.21 ^{a}	3.17 ^{a}	0.6024	0.8364	0.0673
	Clean		3.75 ^{a}	3.60 ^{a}	3.52 ^{a}	0.2115	**0.0002**	0.2216
	Sensitive skin		2.99 ^{a}	2.93 ^{a}	2.65 ^{b}	**0.0115**	**<0.0001**	0.2845
	Clear skin		3.08 ^{a}	3.00 ^{a}	2.79 ^{b}	**0.0476**	**<0.0001**	0.6598
	Smooth		3.57 ^{a}	3.46 ^{a}	3.28 ^{b}	**0.0381**	**0.0041**	0.2008
	Softening		3.33 ^{a}	3.13 ^{ab}	2.92 ^{b}	**0.0140**	**<0.0001**	0.2966
	Soothing		3.32 ^{a}	3.36 ^{a}	3.16 ^{a}	0.1096	**0.0004**	0.3176
	Restoring		3.11 ^{a}	3.15 ^{a}	3.07 ^{a}	0.7345	0.0681	**0.0285**
	Revitalizing		3.41 ^{a}	3.41 ^{a}	3.47 ^{a}	0.8001	**0.0300**	0.2762
	Cooling		3.24 ^{a}	3.28 ^{a}	3.13 ^{a}	0.3157	**0.0016**	**0.0169**
	Heating		2.34 ^{b}	2.63 ^{a}	2.36 ^{b}	**0.0194**	0.3516	0.1260
	Odor protection		3.54 ^{a}	3.39 ^{a}	3.36 ^{a}	0.4833	0.1299	0.6807

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Chapter 6 - Effect of Personality Differences on Olfactory Responses to Masculine Fragrances

Abstract

Personality characteristics have been used for consumer segmentation for behavior and preference and emotion study. It is known that people who had similar personality trait tended to like similar perfumes and responded to the odorants similarly. However, the impact of personality on how it influenced the thoughts, perceptions, and expectations of a person has not been investigated. Therefore, the objective of this study were to investigate the influence of the personality difference on the olfactory responses regards to liking, emotion, perceptions, attitudes, and expectation of individuals in order to understand how personality affects

The results revealed that personality differences did not affect the liking, emotions, attitudes, and expectations of individuals toward the same odorant. However, the differences of personality level influenced on the how individual used the scale. For example, the persons who were more open, extrovert, or agreeable tended to score higher than the others. These findings provided conclusion that the difference in personality traits were not the factors that impact olfactory liking or other responses. This could be concluded that personality might not be the prevalent criteria for consumer segmentation in the fragrance research.

Introduction

The selection process of how individual decides to select or consume a product has been studied widely for food choice and consumption concepts (Furnham & Heaven, 1999; Pettinger, Holdsworth, & Gerber, 2004; Eertmans et al., 2005). Two categories of stimuli, internal (e.g., a product's sensory characteristics) and external (e.g., cognitive information, and individual differences) (Shepherd & Sparks, 1994; Eertmans et al., 2005), have been noted in those studies.

Individual differences or personal factors include an individual's displeasure and preference, demographic characteristics (i.e., age and gender), socio-economic (e.g., income, marital status, and cultural), psychological and physiological needs (e.g., lifestyle, personality traits, moods, emotions, attitudes, and behavior responses) (Rétiveau, 2004; Eertmans et al., 2005; Honkanen, Olsen, & Myrland, 2006). These factors encompassed sensory perception, preference and acceptance, as well as health beliefs and concerns (Furst et al., 1996; Pettinger et al., 2004; Rétiveau, 2004; Eertmans et al., 2005).

Although demographic segmentation has been widely used for segmenting consumers, purchase behavior, i.e. which consumer would buy one product over another, does not necessarily seem to be well explained by demographics alone (Honkanen et al., 2006). Thus, the use of additional information for consumer segmentation such as personality, preference, attitudes, and other psychographic characteristics have been suggested for inclusion in models of produce choice to obtain a better explanation (Kahle & Chiagouris, 1996; McCarty & Shrum, 1993; Riquier, Kennedy, & Sharp, 1998; Honkanen et al., 2006).

Personality is believed to be a foundation of an individual difference because it influences patterns of thoughts, emotions, motivations, and behaviors of a person. Several trait theories were developed to explain and classify personality structures. One of those, the Big-Five personality index describes personality using a five-dimension personality framework (Goldberg,

1990). The five-dimension included: openness to experience (i.e., creative, imaginative, and innovative), conscientiousness (i.e., organized and reliable), extraversion (i.e., sociable, assertive, and talkative), agreeableness (i.e., sympathetic, kind, and understanding), and neuroticism (i.e., anxious, irritable, and emotional) (Goldberg, 1990; McCrae & Costa, 1999).

Personality information can be used as a part of the research for understanding the relationship between personality and other personal variables such as behavior (O'Malley & Gillette, 1984) and mood (Harris & Lucia, 2003). The use of personality characteristics segmentation for purchase behavior or preference study may provide a better segmentation than demographics and thus, better explanation of the choice behavior. For example, in fragrance research, individuals who had a different level of neuroticism had different sensitivity and response to fragrance (Chen & Dalton, 2005). However, differences in extroversion did not affect olfactory performance of individuals (Koelega 1994; Pause, Ferstl, & Fehm-Wolfsdorf, 1998; Larsson, Finkel, & Pedersen, 2000). Some research demonstrated that people who had similar personality traits tended to like similar perfumes. For example, extroverts tended to like fresh, energetic scents while introverts tended to like warm, comforting, and oriental notes (Rétiveau, 2004).

Several research projects investigated how individuals associated terms and odor descriptors with fragrances (Rétiveau, 2004; Jellinek 1992; Zarzo & Stanton 2009; Donna 2009; Lindqvist, 2012a; Lindqvist, 2012b), how the scents impacted perceptions related to physiological and psychological effects (Jellinek 1951; Jellinek 1997; Zarzo & Stanton 2009), and use occasion (Rétiveau, 2004). No research was found that covered how odors impact the expectation of product performance related to functional benefits or related olfactory congruency with personal care products.

Because personality differences can affect a person's olfactory preference or objective performance, the application of personality segmentation seems an appropriate application in research focused on obtaining a complete understanding of the odor effects. Therefore, the objective of this study was to investigate the influence of personality difference on olfactory responses to men's fragrances regarding to olfactory liking, perceptions, and product expectations.

Materials and Methods

Respondents

A total of 300 participants were selected from 976 male and female across the United States who completed the personality survey. Male participants were persons who used cologne, fragrance, or fragranced personal care products (e.g., deodorants, shave gel/cream, shave balm, body wash, etc.) and female participants were persons who liked the smell of cologne, fragrance, or personal care products on men or find themselves attracted to a person who uses these products. The big-five inventory and screening survey for personality classification are showed in Appendix A and B, respectively.

The respondents were divided into subcategories based on demographic information (gender and age [18-25, 26-35, and 36-49]). Fifty participants from each sub-demographic (2 genders x 3 age groups) were randomly selected to participate in this study. The selected participants were also represented 5 different personality patterns (55-73 respondents per personality group) as discussed in Chapter 4.

Odorant Selection

To reduce the variability of gender association with fragrances, only masculine odorants were used in this study. The odorant samples were selected from a pool of odorants used for

personal care products. Researchers selected 4 representative odorant samples and a commercially available cologne for this study. The samples had olfactory characteristics that smelled different from each other. Additionally, each sample had diverse characteristics that covered at least 2-3 subfamilies in Edwards' fragrance wheel (Edwards, 2008) (Table 6.1).

Table 6.1 Selected Odorant Samples and Their Class and Description

Odorant type	Sample	Edwards' classification	Description
Odorant purposely made for personal care product	112	Mossy woods - Citrus	Chypré: moss, citrus, floral, woody
	357	Soft floral - Green	Soapy, vanilla, musk, rose
	413	Floral-Citrus	Lime, violet
	958	Oriental-Floral	Lavender, coconut, anise, musk
Commercial cologne	504	Aromatic	Fougère: geranium, cedar, lime, musk

Sample Preparation

Throughout the study all odorant bottles were stored at room temperature. A 0.5 mL sample of each odorant was transferred on a cotton swab (Qtips®, Uniliver, USA) using a disposable 1 mL tuberculin syringe (sterilized) (Fisher Scientific Inc., PA). The cotton swaps were pre-cut in half, length wise (4 cm). The scented cotton swab then was placed with the swab side down in an evaluation container and labeled with a 3-digit code. The type of container used in this study was an amber vial screw-thread bottle with a black screw-top cap and a white liner (3.7 mL) (Fisher Scientific Inc., PA). Each container was tightly closed immediately after the scented swab was inserted.

All samples were packed individually in a clear bubble bag with a lip and tape (3.5x4 in) (Staple®, USA) to protect them from damage during transportation. Once each sample was packed in a bag, a label having a letter "A" was placed onto a bag to represent the first sample

for evaluation. The other labels (B, C, D, and E), which represented evaluation order from 2nd to 5th, were placed on samples by the assigned presentation order according to the William-modified Latin square design (Meilgaard, Civile, & Carr, 2007). All five samples were packed in a postage box and sent out to participants using the United States Postal Office (USPS). The sample set was assumed to arrive at the destination within 1-3 business days.

The test was conducted when the average temperature across country was at the range of 42-56 °F (National Oceanic and Atmospheric Administration [NCDC], 2012). This information provided assurance that the fragrance samples had not deteriorated during transport.

Internet Survey

Prior to the sample shipment an email was sent to target participants informing them about their qualification. After the samples were shipped each participant received another email notifying them about the package they were to receive and provided the test schedule for 5 odorant samples. The test schedule indicated the dates to complete each sample. The participants were asked to evaluate each sample anytime within the 3 days at their home. They also were asked to evaluate another odorant sample in the following 3 day periods. The online-survey for each sample was available only on the specified dates. The participants could not revisit the survey, and they were not allowed to do a make-up test if missed. The test was available for 2 weeks for the participants to complete. On the evaluation day, respondents were asked to log in to the website and enter the sample code appearing on the label of the sample vial to access the survey. The procedure for the survey is addressed in the following section.

Questionnaires

Emotion Questions and Modification

ScentMove™ (Porcherot et al., 2010) was used for measuring emotion on odorants. The respondents were asked to rate the pertinence of each of the six series of three feeling terms to describe their feelings before and right after smelling the odorant on a 10-cm linear scale ranging from "no feelings" to "very intense feelings". To maximize the scale, the ratings from participants were then translated to numeric values from 0 to 100.

Odorant Acceptance

The hedonic response was asked to participants to indicate how much they liked or disliked the smell of each odorant sample on a 9-point scale where 1 represented dislike extremely to 9 represented like extremely.

Degree of Sensory and Consumer Terms Associated with an Odorant

A checklist consisted of an odor strength rating and sixteen sensory and consumer terms, modified from previous studies and articles (Jellinek, 1992; Higuchi, Shoji, & Hatayama, 2004; Gleason-Allured, 2008; Zarzo & Stanton, 2009; Falk & Penning, 2012; Lindqvist, 2012a; Porcherot et al., 2012), was used as evaluation material. The respondents were asked to indicate the level of terms associated with an odorant using a numerical scale, ranging from 1 = not at all to 5 = extreme.

Agreement/Disagreement on Use Occasion

The respondents were asked to identify the level of their agreement or disagreement toward 11 different situations on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The set of given situations insisted of time of the day, seasons, activities, and occasions developed and modified from the studies of Aarts (2003) and Rétiveau (2004). The simple

question “If you are going to wear this cologne, when would you wear it?” was used to introduce each statement to participants.

Agreement/Disagreement on Potential Application in Personal Care Products

Ten personal care categories modified from Wormuth, Scheringer, & Hungerbühler (2005), were presented to participants. For each personal care category, the participants were asked to indicate how much they agree or disagree on an appropriateness of the scent to be found in a particular category on a 5-point Likert scale (1 = disagree strongly to 5 = agree strongly).

Agreement/Disagreement on Expectation of Functional Benefits

Seventeen functional benefits were presented to participants to investigate the appropriateness of functional benefits would be related to odorants. The participants were asked to think if the scent they smelled, would they expect the personal care products to provide any particular functional benefits. A 5-point Likert scale (1 = disagree strongly to 5 = agree strongly) was provided to participants to indicate their agreement/disagreement on each functional benefit.

Data Analysis

Data Preparation for Emotion Dimensions

The emotion ratings prior to the odorant evaluation were subtracted from the emotion ratings during the evaluation, to reduce the impact of a persons’ initial psychological state, before analyzing the data (Bhumiratana, 2010; Gibson, 2006).

Personality Classification

The classification of participants based on personality was conducted using two different perspectives. The first classification was made based on the similarity/dissimilarity of personality

patterns of all five personality dimensions. The participants were classified into 5 personality patterns, as discussed in Chapter 4.

The second personality classification was made based on each of the big-five personality dimensions. Each dimension was used for categorizing participants into groups based on the strength of personality (very low, low, moderate, high, and very high). Participants who evaluated themselves within two-three continuous levels of a personality may be combined together if the number of participants in each level was less than 20. A total of five data sets were generated.

Analysis of Significant Difference for the Variables of Participants from Different Personality Groups

A total of six data sets (personality patterns and each of the five personality dimension) individually subjected to Analysis of Variance (AOV) using the GLIMMIX procedure at a 5% level of significance (SAS®) performed on the variables. The odorant, personality (i.e., pattern and the five dimensions), and interaction of odorant by personality were used as fixed effects. The respondent was included in the model as a random effect. Mean separation tests (multiple t-tests') were carried out to compare the means to determine if significant differences among personality pattern (or personality level).

For each response variable category, the average responses of all five odorant samples rated by participants from different groups were illustrated in bar charts with asterisk (*) representing a significant difference among groups of participants ($p<0.05$).

Results and Discussion

Effect of Overall Personality Patterns on Olfactory Responses

A total of two hundred forty participants completed the test and provided responses that were not doubtful or showed faulty entry. There were forty-three to sixty participants for each personality pattern (Chapter 4). In addition, the demographic distribution of these participants was found to be similar across the five personality patterns (Table 6.2).

Table 6.2 Personality Patterns and Individual Difference Make-Up of 240 Participants

Personality		Age group (year)			Gender		Total
Pattern	Characteristics	18-25	26-35	36-49	Female	Male	
1	Extreme personality pattern	4	19	24	20	27	47
2	Slightly extreme personality pattern	5	14	24	26	17	43
3	Slightly extreme personality pattern and emotionally labile	10	20	17	17	30	47
4	Emotionally ambivalent	6	20	17	24	19	43
5	Emotionally ambivalent and labile	8	28	24	36	24	60

The average olfactory liking scores across the five odorants were above 6 points on a 9-point hedonic scale, which indicated that these odorants were generally well-liked by all participants even though they had different personality pattern (Figure 6.1a). The analysis showed that all participants had the same olfactory liking toward the same odorant ($p>0.05$) (Supplementary Table 6.1a). However, the participants who had an emotionally ambivalent and labile (pattern 5) generally provided liking score lower than the other participants who had a different personality pattern, especially those in extreme personality patterns 1 and 3 ($p<0.05$). The occurrence of low olfactory liking scores provided by the emotionally ambivalent individuals might be related to the negative relationship between the neurotic trait and how they were responsive and sensitive to the odorants (Chen & Dalton, 2005).

The difference in personality patterns did not affect participant's emotional experience related to specific odorants; the participants experienced the same emotional profile and at the same intensity when the same odorant was smelled ($p>0.05$) (Supplementary Table 6.2a). The presence of odorants generally increased *sensuality, sensory pleasure,* and *refreshment feelings* of all participants. The feeling of *pleasantness* and *unpleasantness* of participants tended to remain unchanged; however, these emotional dimensions varied slightly across personality patterns. In contrast, odorant exposure had a negative effect toward participants' *relaxation*, which decreased after they smelled the odorants (Figure 6.1b).

This study indicated that participants, regardless of personality profile, associated sensory and consumer terms with the same odorants in a similar manner ($p>0.05$) with a few exceptions (Supplementary Table 6.1b). A strong association between most terms and each odorant was observed (Figure 6.1c). However, the term *Asian/*oriental and *feminine* were indicated to be less associated with these odorant samples. In addition, the participants who had an extreme personality pattern (pattern 1-3) associated terms *bold, modern, fresh, harmony, natural, pleasing opposite sex, distinctive*, and *masculine* with odorants more than the participants who had emotionally ambivalent (pattern 4 and 5) ($p<0.05$).

The difference in personality pattern did not affect the types of use occasions appropriate for each odorant ($p>0.05$) (Supplementary Table 6.1b). Respondents perceived each odorant as appropriate for most occasions (except for *sports* and *outdoor* activities) (Figure 6.1d). However, the impact of difference of personality pattern was pronounced on the level of ratings provided. Participants who had an extreme personality pattern (pattern 1-3) tended to score higher than emotionally ambivalent participants for appropriateness of the odor for all use occasions, especially *day* and *night*, as well as *formal* and *casual* occasions ($p<0.05$). Again, this

phenomenon likely was related to the odorant sensitivity of participants who were emotionally ambivalent (Chen & Dalton, 2005). This relationship might modulate how participants, within this category, use the odorants in different occasions as they could be negatively influenced by the smells.

All clusters of participants provided similar responses on the congruency between odorants and personal care products ($p>0.05$). In general, the participants indicated that the odorants were congruent with most personal care products, except for *sun screen* (Figure 6.1e). Again, although the patterns of congruency responses were similar, the participants who had an extreme personality pattern (pattern 1-3) tended to score higher than the other participants. The participants who had the most extreme personality pattern (pattern 1) scored higher than the others for *body wash, body lotion,* and *sunscreen* ($p<0.05$). *Sunscreen* was the only personal care product where participants showed differences in congruence among the five products ($p<0.05$) (Supplementary Table 6.1c).

All participant clusters had the same expectation of functional benefits for the same odorants ($p>0.05$). All clusters indicated they expected all functional benefits for each fragrance except for the *heating* benefit that was only slightly expected (Figure 6.1f). As with the other scales, participants who had an extreme personality pattern (pattern 1-3) tended to have higher scores for functional expectations than did the other personality patters (Figure 6.1f). Even for *heating*, personality pattern 1 had higher scores than the other personality clusters when they smelled the various odorants ($p<0.05$).

Figure 6.1 **Average Responses Across Five Odorants Rated by Participants who had a Different Personality Pattern ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application in Personal Care Products, and [f] Expectation of Functional Benefit) (* Represents Significant Difference among Five Personality Patterns at $p<0.05$)**

Effect of Specific Personality Differences on Olfactory Responses

Because overall personality type seemed to have little influence on emotion, acceptance, congruence, or functional benefit, the participants were re-classified based only on the degree of a single personality dimension, which was the average score of statements related a personality dimension. This grouped individuals differently because rather than their overall personality construct, they were classified only as low to very high for a specific personality dimension depending on the specific dimension. It should be noted that with the exception of extroversion, few people scored low for any specific dimension in this study. That would be expected given the use of a random consumer population without specific personality issues.

Openness to Experience

Participants were moderate to very high in the openness to experience traits. Most people scored high on this dimension. The distribution of participants who had a different openness level was found to be similar across each age group and gender segment (Table 6.3).

Table 6.3 Individual Difference Make-Up of Participants who had a Different Openness to Experience Level

Openness level	Age group (year)			Gender		Total
	18-25	26-35	36-49	Female	Male	
Moderate	7	31	33	32	39	71
High	24	57	68	74	75	149
Very high	2	13	5	11	9	20

The odorants were well-accepted by the participants who had different openness levels (Figure 6.2a). The participants had similar olfactory liking toward the same odorants ($p>0.05$) (Supplementary Table 6.2a). However, the participants who were more open provided higher liking scores than the others who were less open ($p<0.05$).

The participants experienced similar emotions when they smelled the same odorants ($p>0.05$) (Supplementary Table 6.2a). Difference in extroversion did not influence how they rated their emotions. All participants perceived more *sensuality, sensory pleasure,* and *refreshment* after they smelled the odorants. On the other hand, the *relaxation* decreased after smelling these fragrances (Figure 6.2b).

The participants similarly associated each sensory and consumer term to the same odorant ($p>0.05$) (Supplementary Table 6.2b). Most consumer terms were moderately associated with the odorants, except for *Asian/oriental* and *feminine,* which were slightly associated with the odorants (Figure 6.2c). The difference of openness to experience level did not influence how individuals associated each term with the same odorants. For example, the difference in openness to experience did not impact how individuals associated terms *heavy, feminine, European,* and *Asian/oriental* with odorants ($p>0.05$). However, it did influence the number of associations between the terms with an odorant. For example, participants who were very open generally associated the most terms with odorants (Supplementary Table 6.2b).

Differences in openness to experience level did not alter a person's perception of the congruency between an odorant and use occasions. The participants provided the same responses toward the same odorants (Supplementary Table 6.2b). In addition, they also indicated that the odorants were congruent for most occasions, except for *sport* and *outdoor* activities (Figure 6.2d). The participants who were more open rated their agreements higher than other participants in all occasions ($p<0.05$), except for summer and winter season ($p>0.05$).

The participants similarly had similar agreements on product congruency of the same odorants ($p>0.05$) (Supplementary Table 6.2c). The participants who were more open tended to rate their agreements of potential application of an odorant on most of personal care items lower

than participants who were less open (Figure 6.2e). However, the participants who were more open thought the odorants were more congruent for the *body lotion* product category ($p<0.05$) (Supplementary Table 6.2c).

Differences in openness to experience level did not alter individual's expectations of functional benefit. The participants expect the same odorants to provide the same functional benefits ($p>0.05$) (Supplementary Table 6.2c). However, participants who were more open to experience had higher expectations of most functional benefits than participants who were less open ($p<0.05$). In general, all participants indicated that the odorants were congruent with the functional benefits, except for the *heating* property (Figure 6.2f).

Conscientiousness

The participants were moderate to high in conscientiousness with the majority scoring moderate on this dimension. Participants from each age groups and gender segments distributed evenly to the two different level of conscientiousness (Table 6.4).

Table 6.4 Individual Difference Make-Up of Participants who had a Different Conscientiousness Level

Conscientiousness level	Age group (year)			Gender		Total
	18-25	26-35	36-49	Female	Male	
Moderate	11	63	74	73	75	148
High	22	38	32	44	48	92

Figure 6.2 **Average Responses Across Five Odorants Rated by Participants who had a Different Level of Openness ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application in Personal Care Products, and [f] Expectation Of Functional Benefit) (* Represents Significant Difference among Three Openness Levels at $p<0.05$)**

In general, differences in conscientiousness did not affect participant's responses to the odorants based on emotion profiles, liking, term association, use occasion, potential application, and expectation of functional benefit ($p>0.05$) (Figure 6.3). However, participants who were less conscientious associated *Asian/oriental* with odorants more than other participants and appropriateness for *sunscreen* and expectation of *heating* generally were rated higher by participants who were less conscientious ($p<0.05$) (Supplementary Table 6.3a-c).

Extroversion

Participants in this study scored low to very high in extroversion. The extroversion dimension was the only personality dimension that fully covered the range of a personality dimensions. However, most of the participants were moderate to high in extroversion. The participants who rated themselves as low to low-moderate in extroversion were combined in the same group. Similarly for participants who had high-moderate and high extroversion levels were combined together. Participants who were categorized in different categories (age groups and gender segments) were distributed similarly across the low-moderate and high-very high extroversion categories (Table 6.5).

Table 6.5 Individual Difference Make-Up of Participants who had a Different Extroversion Level

Extroversion level	Age group (year)			Gender		Total
	18-25	26-35	36-49	Female	Male	
Low-moderate	14	48	69	64	67	131
High-very high	19	53	37	53	56	109

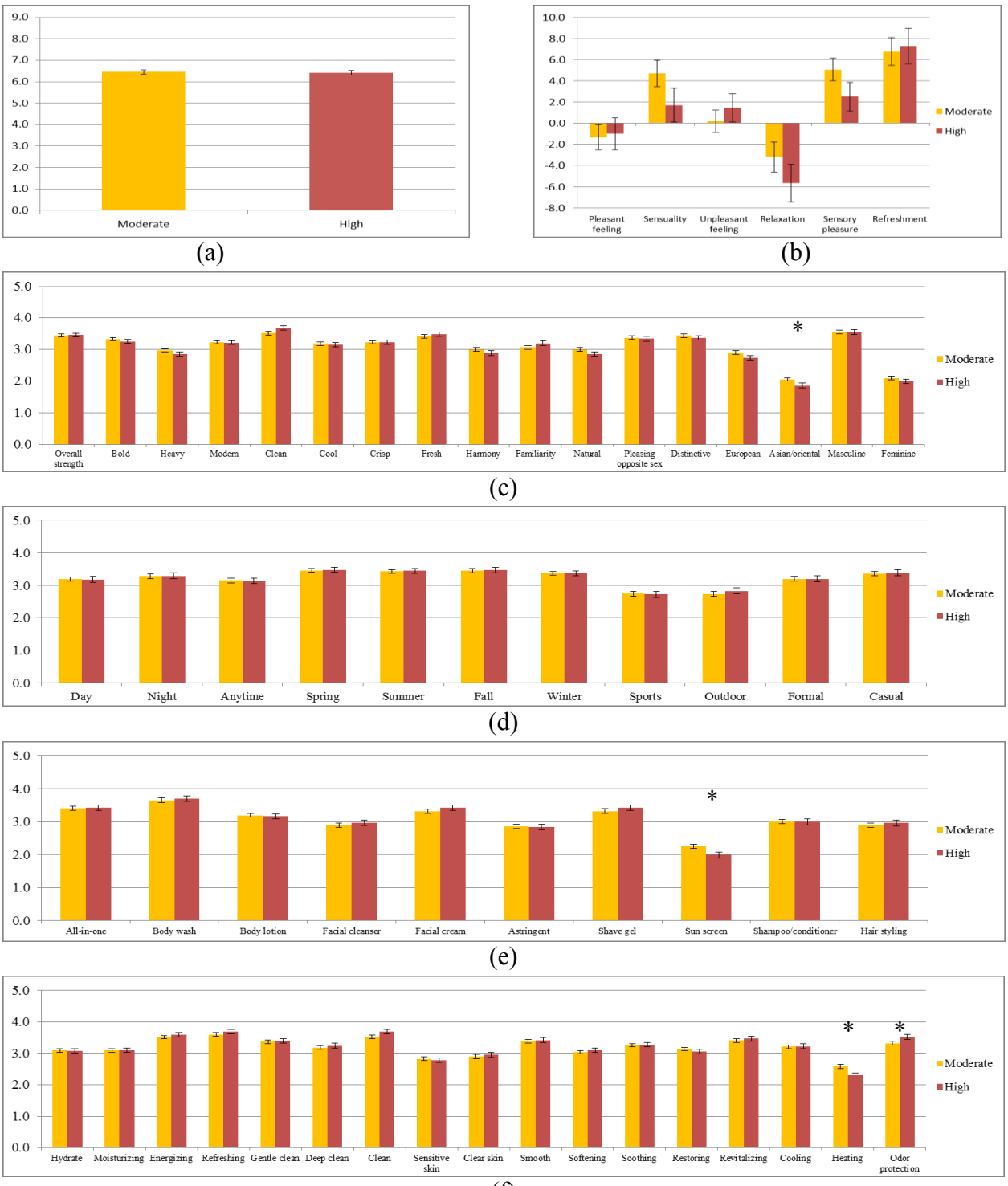


Figure 6.3 **Average Responses Across Five Odorants Rated By Participants who had a Different Level of Conscientiousness ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application In Personal Care Products, and [f] Expectation of Functional Benefit) (* Represents Significant Difference between 2 Conscientiousness Level at $p<0.05$)**

The participants who had a different extroversion level had the same olfactory liking to the same odorant ($p>0.05$) (Supplementary Table 6.3a). Previous studies suggested that extroverts tended to like fresh and energetic scents and that introverts tended to like warm, sweet and oriental notes (Mensing & Beck, 1988; Fiore, 1992; Rétiveau, 2004). Despite the absence of difference in fragrance liking among individuals who possessed different extroversion levels, this difference influenced how participants used the scale. Extroverts tended to score higher than introverts (Figure 6.3), especially for odorant liking and relaxation which were rated significantly higher by the participants who were extroverted ($p<0.05$). In this case, the difference of extroversion level influenced how individuals score the subjective responses. However, the difference of extroversion level did not affect olfactory performance of individuals (Koelega 1994; Pause, Ferstl, & Fehm-Wolfsdorf, 1998; Larsson, Finkel, & Pedersen, 2000).

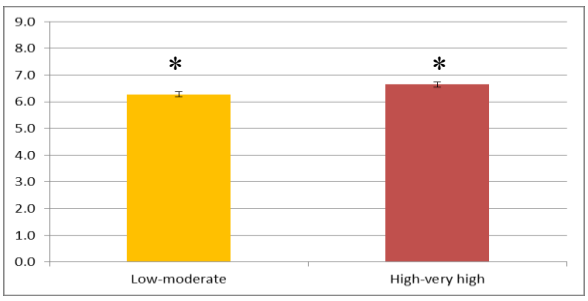
Both introverted and extroverted participants typically associated each consumer term with the same odorant ($p>0.05$). However, the participants did differ in their association of the terms *clean, fresh,* and *harmony* with particular odorants ($p<0.05$) (Supplementary Table 6.3b). In addition, the difference in extroversion level influenced how individuals associated the terms with an odorants. With the exception of *familiarity, feminine, European,* and *Asian/oriental,* the extroverts had higher association scores than introverts ($p<0.05$) (Figure 6.3c).

The odorants were perceived to be suitable for most occasions (Figure 6.3). All participants provided the same rating toward the congruency between the same odorant and use occasion ($p>0.05$) (Supplementary Table 6.3b). In general, the odorants were perceived to be congruent in most occasions, except for *sport* and *outdoor* activities (Figure 6.3d). Again, despite the similarity in the comparison of use occasion, extroverts indicated that the odorants were more

suitable in most occasions (except for *spring, summer*, and *fall*) than the introvert participants ($p<0.05$).

The participants who possessed a different extroversion level had similar ratings toward potential application in personal care items rated for the same odorant ($p>0.05$) (Supplementary Table 6.3c). However, when the results from two groups of participants were compared, the extrovert participants perceived the odorants being more congruent for most personal care products (Figure 6.3e), especially in *sunscreen, shampoo/conditioners*, and *body lotion* ($p<0.05$).

All participants provided the same responses for congruency for the same odorants (Supplementary Table 6.3c). Both extroverts and introverts indicated that the congruency between odorants and most functional benefits was moderate-high (Figure 6.3f). As with previous scales, extroverts had higher expectations for the most functional benefits ($p<0.05$), except for *odor protection, cooling, energizing, refreshing*, and *clean* ($p>0.05$) when compared to the introvert participants.



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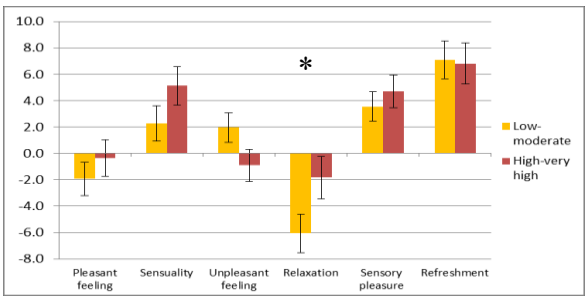

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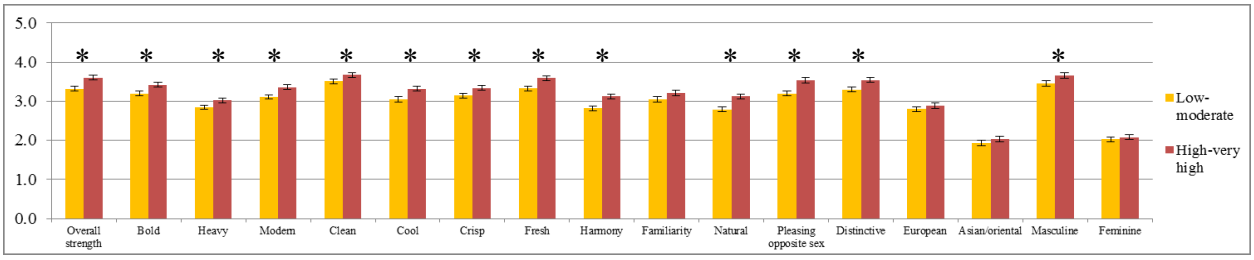

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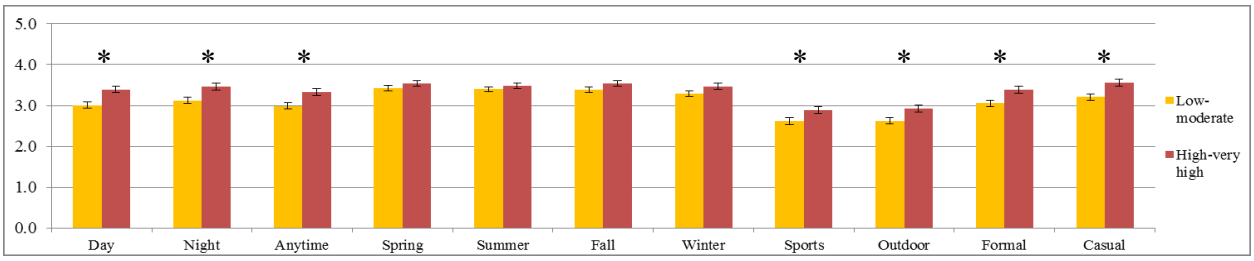

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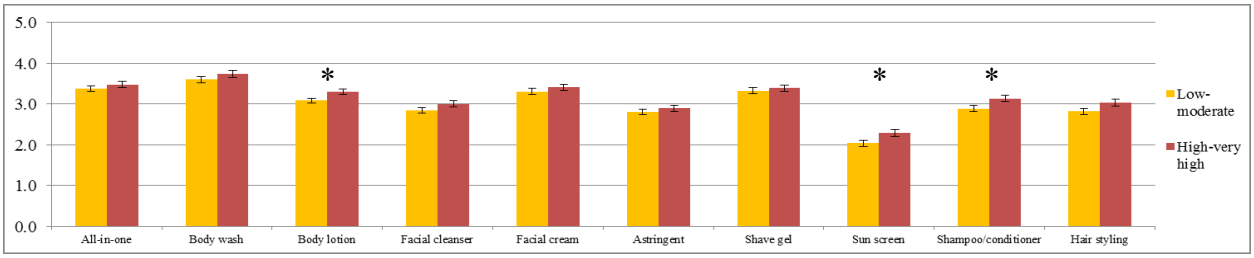

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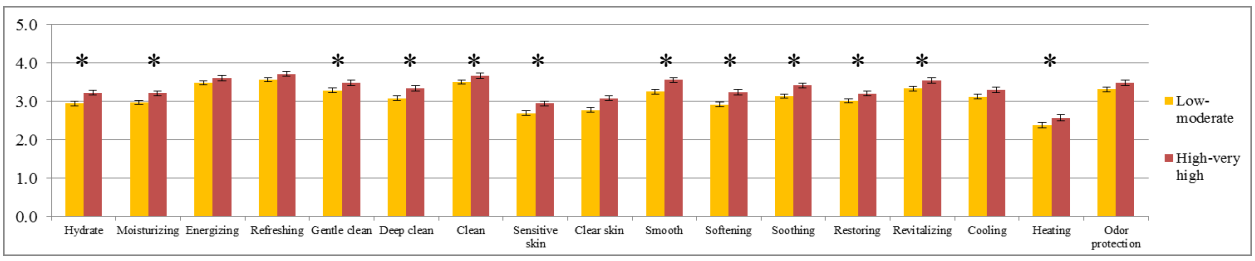


(f)

Figure 6.4 **Average Responses Across Five Odorants Rated by Participants who had a Different Level of Extroversion ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application in Personal Care Products, and [f] Expectation of Functional Benefit) (* Represents Significant Difference between 2 Extroversion Levels at $p<0.05$)**

Agreeableness

Most of participants who participated in this study evaluated themselves to be moderately agreeable, with the remainder showing high agreeableness. Similar ratios for age and gender were found for two different levels of agreeableness (Table 6.6).

Table 6.6 Individual Difference Make-Up of Participants who had a Different Agreeableness Level

Agreeableness level	Age group (year)			Gender		Total
	18-25	26-35	36-49	Female	Male	
Moderate	20	81	87	92	96	188
High	13	20	19	25	27	52

Participants with different levels of agreeableness showed the same olfactory liking and experienced the same emotion profile toward the same odorant ($p>0.05$) (Supplementary 6.4a). The odorants were generally perceived to be well-accepted across both participant groups (Figure 6.4a). The personality difference did not influence how individual provide the ratings. In addition, the finding of emotions related to odorant exposures was similar to the finding from previous personality analyses.

The participants similarly associated sensory and consumer terms with the same odorant ($p>0.05$) (Supplementary Table 6.3b). In general, most consumer terms were moderately associated with the odorants, except for the *Asian/*oriental and *feminine* which were less associated with the odorants (Figure 6.3c). The terms *clean, cool, crisp,* and *fresh* were the terms that the participants who were more agreeable associated more with each odorant than participants who were less agreeable ($p<0.05$).

The difference of agreeableness level did not affect the use occasion responses. The participants provided the same ratings for use occasion toward the same odorants ($p>0.05$)

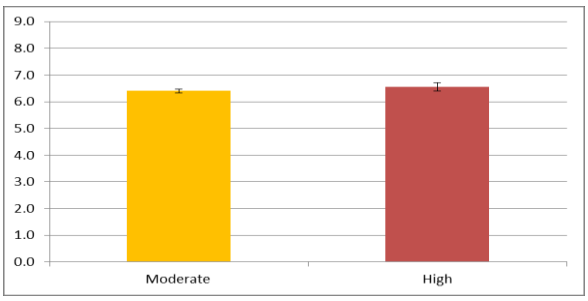
(Supplementary Table 6.3b). All of the participants generally perceived the odorants being suitable in most occasions (Figure 6.3d).

All participants provide the same ratings for potential application to personal care products toward the same odorants ($p>0.05$) (Supplementary Table 6.4c). The participant similarly perceived the odorants to be congruent with most product category, except for the sun screen product (Figure 6.4e).

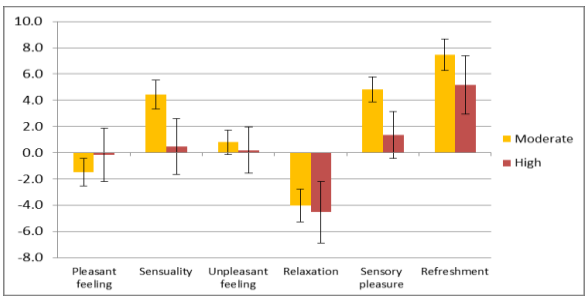
All participants had the same expectation of functional benefits toward the same odorants ($p>0.05$) (Supplementary Table 6.4c). The participants generally had moderate to high expectation of each functional benefits, except for the *heating* property which was not expected with these odorants (Figure 6.4f). In this case, participants who were more agreeable generally had higher expectation for the most functional benefits than participants who were less agreeable ($p<0.05$), except for the expectation of e*nergizing*, *refreshing*, *clean*, *sensitive skin, revitalizing*, and *cooling* ($p>0.05$).

Neuroticism

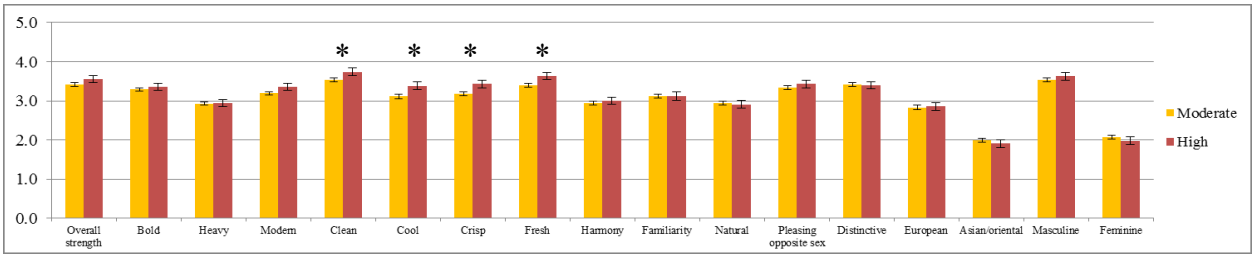
The participants scored themselves as low-high in neuroticism. The majority of the participants possessed moderate to high neuroticism. Only a few participants scored low in neuroticism and these individuals were combined with those who possessed moderate neuroticism. The number of participants from different age group and gender segments was similar in each neuroticism level (Table 6.7).



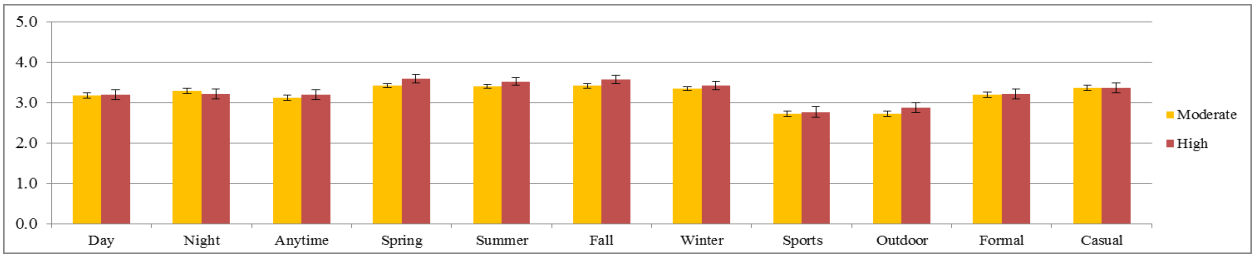
(a)



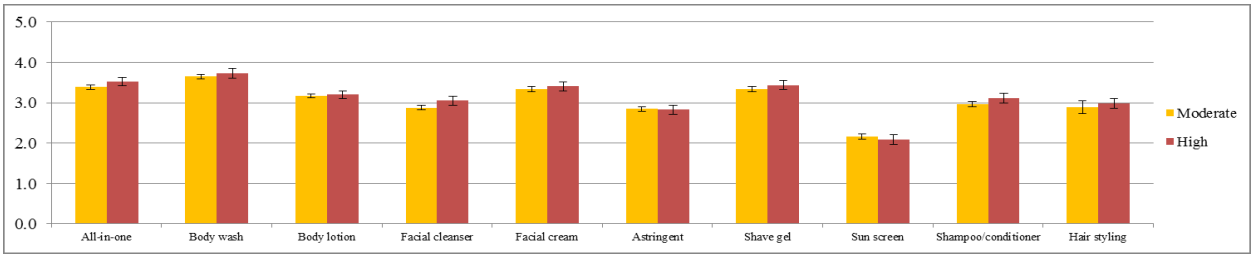
(b)



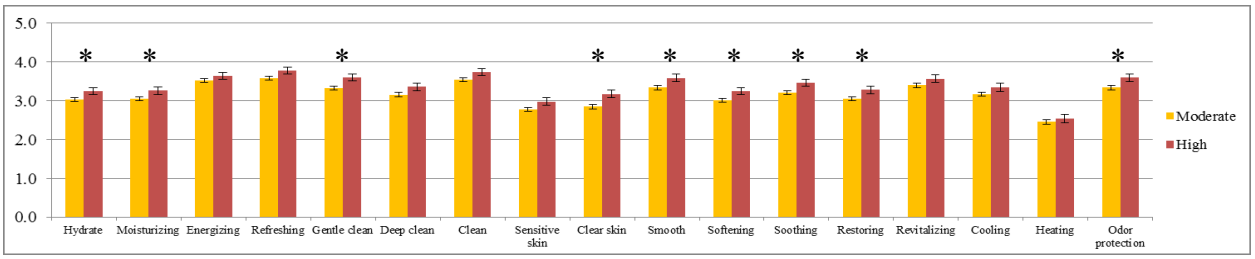
(c)



(d)



(e)



(f)

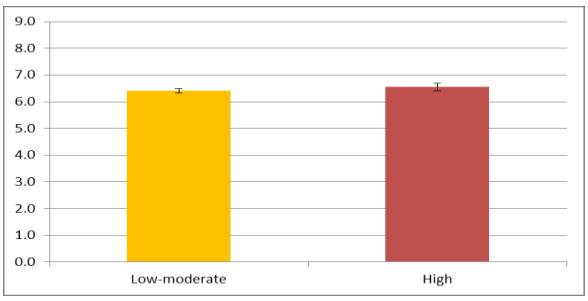
Figure 6.5 **Average Responses Across Five Odorants Rated by Participants who had a Different Level of Agreeableness ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application in Personal Care Products, and [f] Expectation of Functional Benefit) (* Represents Significant Difference between 2 Agreeableness Levels at $p<0.05$)**

Table 6.7 Individual Difference Make-Up of Participants who had a Different Neuroticism Level

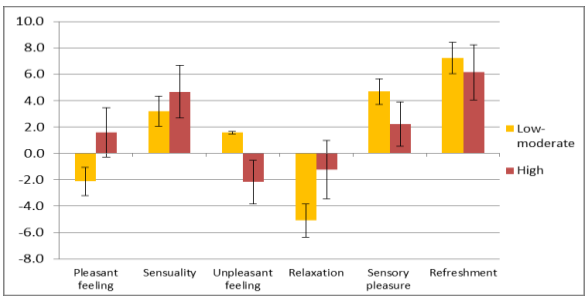
Neuroticism level	Age group (year)			Gender		Total
	18-25	26-35	36-49	Female	Male	
Low-Moderate	20	72	89	85	96	181
High	13	29	17	32	27	59

Within the same odorants, the responses obtained from the participants who had a different neuroticism level were similar to each other ($p>0.05$) (Supplementary 6.5a). This phenomenon was found to be similar to the results classified based on conscientiousness level. There was no significant difference between responses obtained from participants who were different in neuroticism. However, the participants who were more neurotic generally scored slightly higher than the others who had less neuroticism (Figure 6.5). The results were similar to Chen and Dalton's conclusion (2005) that persons who were high in anxiety trait were more responsive and sensitive for odorants than those who had lower anxiety trait.

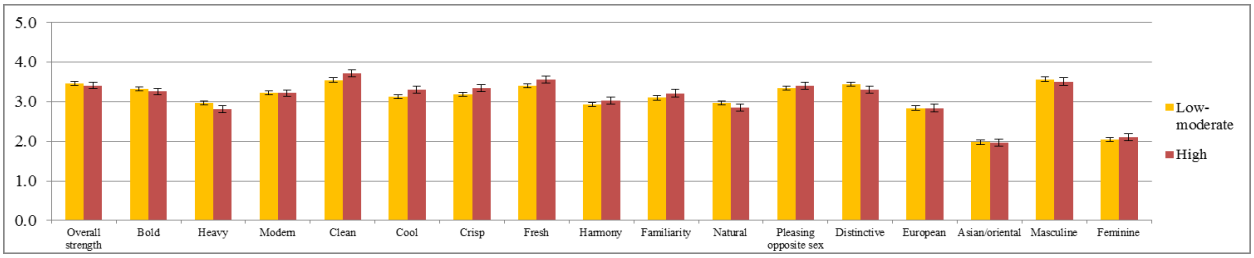
Despite the similarity of olfactory liking between two groups of participants in this study who had a different neuroticism level, previous studies have shown that individuals who were less neurotic (emotionally stable) tended to like fragrances characterized as floral and chypré. In contrast, fragrances characterized as floral-aldehyde, and powdery tended to fit well with the emotionally unstable (neurotic) persons (Mensing & Beck, 1988; Rétiveau, 2004).



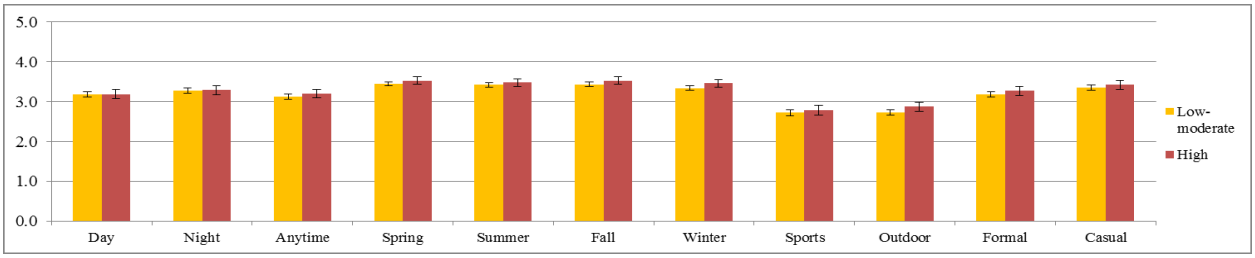
(a)



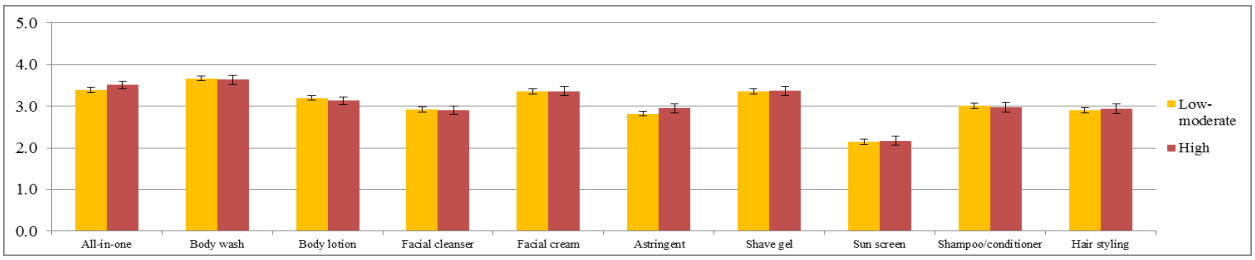
(b)



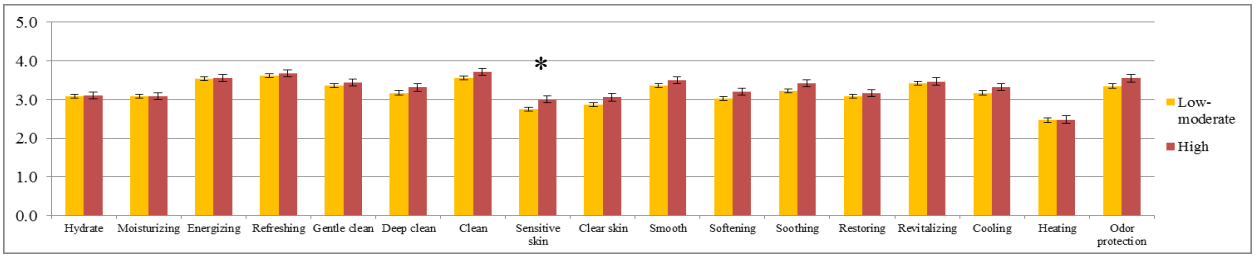
(c)



(d)



(e)



(f)

Figure 6.6 **Average Responses Across Five Odorants Rated by Participants who had a Different Level of Neuroticism ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Use Occasion, [e] Potential Application in Personal Care Products, and [f] Expectation of Functional Benefit) (* Represents Significant Difference Between 2 Neuroticism Levels at $p<0.05$)**

Conclusions

The use of personality characteristics for consumer segmentation did not seem to provide explanations of differences in this study of men's fragrances. Participants who had a different personality pattern or possessed a different strength of specific personality traits experienced the same emotion profile and had the same olfactory liking toward the same odorants. All participants also similarly associated terms with the same odorant. Despite the personality difference among the participants, the participants had the same responses related to use occasion, congruency between scents and products, as well as functional expectation of the same odorants. This could be because the fragrances were all actual men's fragrances and, thus, were equally well liked or appropriate or because personality actually had little or no impact on the products' evaluation.

The difference in personality did have a minor impact on how individuals used the scale. Persons who possessed a higher level of openness to experience, extroversion, and agreeableness trait also tended to score some aspects of the scales higher than the others who possessed a lower level of these personality dimensions. This may be related either to a tendency for certain people to score higher than others on many types of scales or may reflect an actual difference in scoring based on personality type.

References

Aarts, P. (2003). Fragrances with real impact. *Perfumer and Flavorist*, *28*(5), 34-49.

Bhumiratana, N. (2010). *The Development of an Emotion Lexicon for the Coffee Drinking Experience (Doctoral Dissertation).* Retrieved from http://krex.k-state.edu/dspace/handle/2097/7010

Chen, D., & Dalton, P. (2005). The effect of emotion and personality on olfactory perception. *Chemical Senses, 30*,345–351. doi:10.1093/chemse/bji029

Donna, L. (2009, December). Fragrance perception is everything relative? *Perfumer and Flavorist*. *34,* 26-35.

Eertmans, A., Victoir, A., Vansant, G., & Bergh, O. V. D. (2005). Food-related personality trait, food choice motives and food intake: Mediator and moderator relationship. *Food Quality and Preference*, *16*(8), 714-726.

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/153230175.html?page=2

Fiore, A. M. (1992). Effect of composition of olfactory cues on impressions of personality. *Journal of Social Behavior and Personality*, *20,* 149–162.

Furnham, A., & Heaven, P. (1999). Personality and consumption. In A. Furnham & P. Heaven (Eds.), *Personality and Social Behavior* (pp. 247-279). London: Arnold.

Furst, T., Connors, M., Bisogni, C. A., Sobal, J., & Falk, L. W. (1996). Food choice: A conceptual model of the process. *Appetite*, *26*(3), 247-265.

Gibson, E. L. (2006). Emotional influences on food choice: Sensory, physiological and psychological pathways. *Physiology & Behavior*, *89*(1), 53-61. doi.10.1016/j.physbeh.2006.01.024

Gleason-Allured, J. (2008, October). Scentworld 2008 report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist.com/events/coverage/31286474.html

Goldberg, L.R. (1990). An alternative "description of personality": The Big-Five factor structure. *Journal of Personality and Social Psychology*, 59, 1216-1229.

Harris, J.A., & Lucia, A. (2003). The relationship between self-report mood and personality. *Personality and Individual Differences*, 35, 1903-1909.

Higuchi, T., Shoji, K., & Hatayama, T. (2004), Multidimensional scaling of fragrances: A comparison between the verbal and non-verbal methods of classifying fragrances. *Japanese Psychological Research*, *46* (1), 10–19. doi: 10.1111/j.1468-5884.2004.00232.x

Honkanen, P., Olsen, S. O., & Myrland, Ø. (2006). Preference-based segmentation: A study of meal preferences among Norwegian teenagers. *Journal of Consumer Behaviour*, *3,* 235–250. doi: 10.1002/cb.137

Jellinek, J. S. (1992). Perfume classification: A new approach. In S. Van Toller & G. H. Dodd (Eds.), *Fragrance: The Psychology and Biology of Perfume* (pp. 229–242). London, U.K: Chapman and Hall.

Jellinek, P. (1951). *Die Psychologischen Grundlagen der Parfümerie*. Heidelberg: Alfred Hüthig Verlag.

Jellinek, P. (1997). The psychological basis of perfumery. In J. S. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp.1-162). London: Chapman and Hall.

Kahle, L., & Chiagouris, C. (1996). *Values, Lifestyles, and Psychographics*. Hillsdale, NJ: Erlbaum.

Koelega, H. S. (1994). Sex differences in olfactory sensitivity and the problem of the generality of smell acuity. *Perceptual & Motor Skills*, *78*, 203–213.

Larsson, M., Finkel, D., & Pedersen, N. L. (2000). Odor identification: Influences of age, gender, cognition, and personality. *Journal of Gerontology, 55B*, 304–310.

Lindqvist, A. (2012a). Perfume preferences and how they are related to commercial gender classifications of fragrances. *Chemosensory Perception*, *5*(2), 197-204. doi: 10.1007/s12078-012-9119-7

Lindqvist, A. (2012b). Preference and gender associations of perfumes applied on human skin. *Journal of Sensory Studies*, *27,* 490–497. doi:10.1111/joss.12014

McCarty, J. A., & Shrum, L. J. (1993). The role of personal values and demographics in predicting television viewing behavior— Implications for theory and application. *Journal of Advertising*, *22*(4), 77–101.

McCrae, R.R., & Costa, P.T., JR (1999). A Five-factor theory of personality. In L.A. Pervin & O.P. John (Eds.), *Handbook of Personality: Theory and Research* (2nd ed) (pp. 139-153). New York: Guilford press.

Mensing, J., & Beck, C. (1988) The psychology of fragrance selection. In Van Toller, S., & Dodd, G. H. (Eds.), Perfumery: *The Psychology and Biology of Fragrance* (pp. 185-204). London, Chapman & Hall.

National Oceanic and Atmospheric Administration. (2012). *National Climatic Data Center (NCDC): The World's Largest Active Archive of Weather and Climate Data Producing and Supplying Data and Publications for the World*. Retrieved from http://www.ncdc.noaa.gov

O'Malley, M.N., & Gillette, C.S. (1984). Exploring the relations between traits and emotions. *Journal of Personality, 52*(3), 274–284.

Pause, B. M., Ferstl, R., & Fehm-Wolfsdorf, G. (1998). Personality and olfactory sensitivity. *Journal of Research in Personality, 32*, 510–518.

Pettinger, C., Holdsworth, M., & Gerber, M. (2004). Psycho-social influences on food choice in southern France and central England. *Appetite*. *42*(3), 307-316.

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. doi: 10.1016/j.foodqual.2011.07.006

Porcherot, C., Delplanque, S., Raviot-Derrien, S., Le Calvé, B., Chrea, C., Gaudreau, N., Cayeux, I. (2010). How do you feel when you smell this? Optimization of a verbal measurement of odor-elicited emotions. *Food Quality and Preference, 21*, 938–947

Rétiveau, A. N. (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRétiveau2004.pdf?sequence=1

Riquier, C., Kennedy, R., & Sharp, B. (1998). Behaviours versus demographics as identifiers of chad splits: Implementation for segment formation. *Journal of Segmentation in Marketing*, *2*(1), 111–129.

Shepherd, R., & Sparks, P. (1994). Modeling food choice. In H. J. H. MacFie & D. M. H. Thomson (Eds.), *Measurement of Food Preferences* (pp. 202-225). Glasgow: Chapman and Hall.

Wormuth, M., Scheringer, M., & Hungerbühler, K. (2005), Linking the use of scented consumer products to consumer exposure to polycyclic musk fragrances. *Journal of Industrial Ecology*, *9,* 237–258. doi: 10.1162/1088198054084626

Zarzo, M., & Stanton, D. T. (2009). Understanding the underlying dimensions in perfumers' odor perception space as a basis for developing meaningful odor maps. *Attention, Perception, and Psychophysics*, *71,* 225–247.

Supplementary Results for Chapter 6

Supplementary Table 6.1a Overall Analysis of Personality Pattern Effect on Odorant Liking Scores and Net Average Emotion Responses toward 5 Odorant Samples Rated by Consumers from Five Personality Patterns

Response		Personality pattern					p-value		
		1 (n=47)	2 (n=43)	3 (n=47)	4 (n=43)	5 (n=60)	Pattern	Sample	Interaction
Hedonic	Odorant liking	6.81 [a]	6.41 [ab]	6.51 [a]	6.45 [ab]	6.08 [b]	**0.0177**	**<0.0001**	0.4535
Emotion Series	*Pleasant Feeling*	-0.67 [a]	-2.82 [a]	1.01 [a]	-0.45 [a]	-2.77 [a]	0.6450	**0.0012**	0.1664
	Sensuality	5.04 [a]	2.98 [a]	4.51 [a]	2.09 [a]	3.13 [a]	0.8932	**0.0011**	0.7976
	Unpleasant Feeling	2.17 [a]	2.91 [a]	-2.86 [a]	-0.54 [a]	1.49 [a]	0.1868	**<0.0001**	0.2033
	Relaxation	-0.98 [a]	-6.49 [a]	-5.75 [a]	0.03 [a]	-6.66 [a]	0.1445	**<0.0001**	0.8114
	Sensory Pleasure	7.81 [a]	1.97 [a]	5.32 [a]	3.12 [a]	2.38 [a]	0.1523	0.1083	0.7094
	Refreshment	6.17 [a]	7.36 [a]	10.25 [a]	6.13 [a]	5.32 [a]	0.5906	**<0.0001**	0.1481

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.1b Overall Analysis of Personality Pattern Effect on Average Level of Sensory and Consumer Terms Associated with Five Odorant Samples and Use Occasion Rated by Consumers from Five Personality Patterns

Response			Personality pattern					p-value		
			1 (n=47)	2 (n=43)	3 (n=47)	4 (n=43)	5 (n=60)	Pattern	Sample	Interaction
Sensory and consumer terms	*Overall strength*		3.68 [a]	3.47 [a]	3.42 [a]	3.31 [a]	3.37 [a]	0.0508	**<0.0001**	0.3117
	Bold		3.55 [a]	3.36 [ab]	3.24 [b]	3.27 [b]	3.14 [b]	**0.0129**	**<0.0001**	0.6958
	Heavy		3.06 [a]	2.89 [a]	2.94 [a]	2.88 [a]	2.89 [a]	0.6326	**<0.0001**	0.7639
	Modern		3.54 [a]	3.14 [b]	3.20 [b]	3.11 [b]	3.14 [b]	**0.0046**	**0.0003**	0.7350
	Clean		3.75 [a]	3.38 [a]	3.66 [a]	3.49 [a]	3.48 [a]	0.0656	**<0.0001**	0.6880
	Cool		3.7 [a]	3.01 [a]	3.18 [a]	3.11 [a]	3.14 [a]	0.0875	**<0.0001**	0.8075
	Crisp		3.44 [a]	3.08 [a]	3.20 [a]	3.27 [a]	3.17 [a]	0.1415	**<0.0001**	0.8581
	Fresh		3.66 [a]	3.28 [c]	3.58 [ab]	3.37 [bc]	3.36 [bc]	**0.0258**	**<0.0001**	0.9688
	Harmony		3.26 [a]	2.78 [b]	3.03 [ab]	2.90 [b]	2.83 [b]	**0.0066**	**<0.0001**	0.6865
	Familiarity		3.10 [a]	2.98 [a]	3.32 [a]	3.21 [a]	3.02 [a]	0.1514	**0.0074**	0.5054
	Natural		3.32 [a]	2.80 [b]	3.06 [b]	2.84 [b]	2.73 [b]	**<0.0001**	**<0.0001**	0.5288
	Pleasing opposite sex		3.60 [a]	3.35 [ab]	3.46 [a]	3.34 [ab]	3.11 [b]	**0.0063**	**0.0025**	0.2628
	Distinctive		3.64 [a]	3.44 [ab]	3.46 [ab]	3.25 [b]	3.27 [b]	**0.0229**	0.1444	0.3874
	European		2.99 [a]	2.75 [a]	2.80 [a]	2.73 [a]	2.88 [a]	0.4146	0.2731	0.3497
	Asian/Oriental		2.13 [a]	1.88 [a]	1.88 [a]	2.00 [a]	1.99 [a]	0.4278	0.1125	0.9441
	Masculine		3.70 [a]	3.74 [a]	3.64 [ab]	3.31 [c]	3.40 [bc]	**0.0117**	**<0.0001**	0.7856
	Feminine		2.10 [a]	1.80 [a]	2.11 [a]	2.14 [a]	2.08 [a]	0.1559	**<0.0001**	0.9095
Use occasion	Time	Day	3.52 [a]	3.14 [bc]	3.36 [ab]	2.99 [c]	2.95 [c]	**0.0030**	**<0.0001**	0.7076
		Night	3.58 [a]	3.36 [ab]	3.31 [ab]	3.08 [b]	3.10 [a]	**0.0372**	0.0811	0.7821
		Anytime	3.40 [a]	3.10 [a]	3.26 [a]	3.02 [a]	2.98 [a]	0.0736	**0.0006**	0.8590
	Season	Spring	3.62 [a]	3.53 [a]	3.55 [a]	3.36 [a]	3.32 [a]	0.1581	**<0.0001**	0.2618
		Summer	3.55 [a]	3.52 [a]	3.48 [a]	3.37 [a]	3.30 [a]	0.3336	**<0.0001**	0.9079
		Fall	3.63 [a]	3.53 [a]	3.49 [a]	3.36 [a]	3.32 [a]	0.2220	0.0772	0.3643
		Winter	3.53 [a]	3.40 [a]	3.34 [a]	3.31 [a]	3.28 [a]	0.4566	**0.0134**	0.5961
	Activity	Sports	2.96 [a]	2.73 [a]	2.72 [a]	2.61 [a]	2.66 [a]	0.4317	**0.0044**	0.6913
		Outdoor	2.93 [a]	2.63 [a]	2.89 [a]	2.71 [a]	2.67 [a]	0.3708	**0.0242**	0.8316
		Formal	3.48 [a]	3.26 [ab]	3.27 [ab]	3.07 [b]	2.97 [b]	**0.0382**	**0.0026**	0.8739
		Casual	3.67 [a]	3.38 [ab]	3.44 [ab]	3.16 [b]	3.22 [b]	**0.0408**	**0.0006**	0.9709

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.1c Overall Analysis of Personality Pattern Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits toward Five Odorant Samples Rated by Consumers from Five Personality Patterns

Response			Personality pattern					p-value		
			1 (n=47)	2 (n=43)	3 (n=47)	4 (n=43)	5 (n=60)	Pattern	Sample	Interaction
Application	Body care	*All-in-one*	3.54 [a]	3.43 [a]	3.47 [a]	3.26 [a]	3.38 [a]	0.4390	**<0.0001**	0.8105
		Body wash	3.84 [a]	3.72 [ab]	3.80 [ab]	3.44 [c]	3.55 [b]	**0.0171**	**<0.0001**	0.7309
		Body lotion	3.46 [a]	3.13 [b]	3.25 [ab]	3.14 [b]	2.98 [b]	**0.0245**	**<0.0001**	0.2131
	Facial care	*Facial cleanser*	3.09 [a]	2.89 [a]	2.87 [a]	2.89 [a]	2.86 [a]	0.6422	**<0.0001**	0.8132
		Facial cream	3.48 [a]	3.48 [a]	3.19 [a]	3.26 [a]	3.36 [a]	0.2886	**0.0117**	0.2741
		Astringent	3.09 [a]	2.80 [a]	2.70 [a]	2.83 [a]	2.82 [a]	0.2087	**0.0006**	0.9689
		Shave gel	3.51 [a]	3.47 [a]	3.18 [a]	3.34 [a]	3.31 [a]	0.3013	**0.0012**	0.1908
		Sunscreen	2.55 [a]	2.04 [b]	1.86 [b]	2.16 [b]	2.13 [b]	**0.0029**	**<0.0001**	**0.0172**
	Hair care	*Shampoo and conditioner*	3.26 [a]	2.97 [a]	2.99 [a]	2.86 [a]	2.93 [a]	0.2047	**<0.0001**	0.8411
		Hair styling	3.19 [a]	2.80 [a]	2.79 [a]	3.02 [a]	2.81 [a]	0.1020	**<0.0001**	0.4766
Functional benefit	*Hydrate*		3.29 [a]	3.07 [a]	3.14 [a]	3.00 [a]	2.95 [a]	0.0920	**<0.0001**	0.7533
	Moisturizing		3.23 [a]	3.13 [a]	3.17 [a]	3.03 [a]	2.94 [a]	0.1763	**<0.0001**	0.6094
	Energizing		3.72 [a]	3.57 [a]	3.63 [a]	3.40 [a]	3.42 [a]	0.0723	**<0.0001**	0.9126
	Refreshing		3.75 [a]	3.67 [a]	3.74 [a]	3.52 [a]	3.52 [a]	0.1999	**0.0002**	0.9390
	Gentle clean		3.57 [a]	3.31 [a]	3.49 [a]	3.26 [a]	3.29 [a]	0.0922	**<0.0001**	0.4082
	Deep clean		3.37 [a]	3.09 [a]	3.17 [a]	3.23 [a]	3.17 [a]	0.4567	0.1857	0.4361
	Clean		3.69 [a]	3.47 [a]	3.73 [a]	3.47 [a]	3.56 [a]	0.2050	**<0.0001**	0.6670
	Sensitive skin		2.96 [a]	2.73 [a]	2.83 [a]	2.80 [a]	2.76 [a]	0.6451	**<0.0001**	0.9624
	Clear skin		3.05 [a]	2.82 [a]	2.92 [a]	2.92 [a]	2.88 [a]	0.6640	**<0.0001**	0.8229
	Smooth		3.58 [a]	3.32 [a]	3.51 [a]	3.35 [a]	3.24 [a]	0.0624	**<0.0001**	0.9217
	Softening		3.26 [a]	2.91 [a]	3.22 [a]	3.02 [a]	2.93 [a]	0.0562	**<0.0001**	0.7602
	Soothing		3.43 [a]	3.14 [a]	3.39 [a]	3.24 [a]	3.15 [a]	0.1543	**<0.0001**	0.8548
	Restoring		3.32 [a]	3.15 [a]	3.05 [a]	3.08 [a]	2.97 [a]	0.1206	**0.0034**	0.4579
	Revitalizing		3.58 [a]	3.43 [a]	3.57 [a]	3.30 [a]	3.32 [a]	0.1175	**0.0003**	0.8261
	Cooling		3.37 [a]	3.19 [a]	3.20 [a]	3.16 [a]	3.14 [a]	0.5103	**<0.0001**	0.9816
	Heating		2.71 [a]	2.31 [b]	2.31 [b]	2.58 [ab]	2.45 [ab]	**0.0364**	0.1297	0.3873
	Odor protection		3.43 [a]	3.47 [a]	3.46 [a]	3.33 [a]	3.32 [a]	0.7926	**0.0039**	0.8345

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.2a Overall Analysis of Openness to Experience Effect on Odorant Liking Scores and Net Average Emotion Responses across 5 Odorant Samples Rated by Consumers who had a Different Openness to Experience Level

Response		Level			p-value		
		Moderate (n=71)	High (n=149)	Very High (n=20)	Level	Sample	Interaction
Hedonic	Odorant liking	6.12 [b]	6.55 [a]	6.71 [a]	**0.0131**	**0.0003**	0.9910
Emotion series	*Pleasant feeling*	-4.01 [a]	0.19 [a]	-1.73 [a]	0.1298	0.0862	0.5925
	Sensuality	0.77 [a]	5.20 [a]	1.27 [a]	0.1062	**0.0143**	0.4398
	Unpleasant feeling	1.05 [a]	0.22 [a]	2.57 [a]	0.7094	**0.0017**	0.7992
	Relaxation	-7.36 [a]	-2.84 [a]	-2.40 [a]	0.1604	**0.0127**	0.6376
	Sensory pleasure	3.43 [a]	3.90 [a]	7.74 [a]	0.4096	**0.0368**	0.6683
	Refreshment	7.62 [a]	7.31 [a]	2.05 [a]	0.3622	**0.0005**	0.5593

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.2b Overall Analysis of Openness to Experience Effect on Average Level of Sensory and Consumer Terms Associated with Five Odorant Samples and Use Occasion Rated by Consumers who had a Different Openness to Experience Level

Response			Level			p-value		
			Moderate (n=71)	High (n=149)	Very High (n=20)	Level	Sample	Interaction
Sensory and consumer terms	*Overall strength*		3.28 [b]	3.48 [a]	3.74 [a]	**0.0077**	**<0.0001**	0.5733
	Bold		3.18 [b]	3.32 [ab]	3.61 [a]	**0.0207**	**<0.0001**	0.6292
	Heavy		2.87 [a]	2.93 [a]	3.11 [a]	0.3281	**<0.0001**	0.6955
	Modern		3.05 [b]	3.30 [a]	3.33 [a]	**0.0220**	**0.0092**	0.3239
	Clean		3.37 [b]	3.61 [a]	3.69 [a]	**0.0329**	**0.0228**	0.7171
	Cool		2.94 [b]	3.26 [a]	3.38 [a]	**0.0028**	**0.0013**	0.9883
	Crisp		3.01 [b]	3.33 [a]	3.25 [ab]	**0.0067**	**0.0113**	0.5674
	Fresh		3.24 [b]	3.52 [a]	3.66 [a]	**0.0039**	**0.0020**	0.7693
	Harmony		2.77 [b]	3.00 [a]	3.31 [a]	**0.0040**	**0.0094**	0.9060
	Familiarity		2.94 [b]	3.17 [a]	3.43 [a]	**0.0165**	**0.0360**	0.4547
	Natural		2.76 [c]	2.98 [b]	3.31 [a]	**0.0040**	**0.0223**	0.5210
	Pleasing opposite sex		3.08 [b]	3.45 [a]	3.68 [a]	**0.0001**	0.4212	0.9417
	Distinctive		3.24 [c]	3.44 [b]	3.75 [a]	**0.0061**	0.2064	0.6283
	European		2.75 [a]	2.87 [a]	2.90 [a]	0.4993	0.3641	0.8789
	Asian/Oriental		1.97 [a]	1.96 [a]	2.12 [a]	0.6405	0.4564	0.7319
	Masculine		3.32 [b]	3.65 [a]	3.67 [a]	**0.0064**	**<0.0001**	0.8473
	Feminine		2.07 [a]	2.01 [a]	2.30 [a]	0.2202	**<0.0001**	0.2677
Use occasion	Time	Day	2.92 [c]	3.24 [b]	3.65 [a]	**0.0013**	**0.0035**	0.8833
		Night	3.07 [b]	3.32 [ab]	3.73 [a]	**0.0114**	0.6496	0.8636
		Anytime	2.96 [b]	3.18 [ab]	3.54 [a]	**0.0175**	0.0530	0.9547
	Season	Spring	3.31 [b]	3.51 [a]	3.75 [a]	**0.0235**	**<0.0001**	0.9950
		Summer	3.35 [a]	3.45 [a]	3.60 [a]	0.3446	**<0.0001**	0.9086
		Fall	3.33 [b]	3.47 [b]	3.83 [a]	**0.0271**	0.5676	0.9088
		Winter	3.27 [a]	3.37 [a]	3.67 [a]	0.0992	0.1124	0.9913
	Activity	Sports	2.45 [b]	2.85 [a]	2.85 [ab]	**0.0099**	**0.0146**	0.4730
		Outdoor	2.49 [b]	2.87 [a]	2.93 [a]	**0.0084**	0.3578	0.7455
		Formal	2.99 [b]	3.23 [b]	3.69 [a]	**0.0058**	0.4097	0.7281
		Casual	3.09 [b]	3.45 [a]	3.77 [a]	**0.0020**	0.1029	0.6339

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.2c Overall Analysis of Openness to Experience Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits of Five Odorant Samples Rated by Consumers who had a Different Openness to Experience Level

Response			Level			p-value		
			Moderate (n=71)	High (n=149)	Very High (n=20)	Level	Sample	Interaction
Personal care	Body care	*All-in-one*	3.33 [a]	3.46 [a]	3.39 [a]	0.4489	**0.0297**	0.6843
		Body wash	3.52 [a]	3.72 [a]	3.77 [a]	0.0881	**0.0015**	0.1358
		Body lotion	2.98 [b]	3.23 [a]	3.49 [a]	**0.0128**	**<0.0001**	0.2674
	Facial care	*Facial cleanser*	2.81 [a]	3.00 [a]	2.73 [a]	0.1432	**0.0013**	0.6887
		Facial cream	3.25 [a]	3.42 [a]	3.18 [a]	0.1926	0.1597	0.7890
		Astringent	2.74 [a]	2.91 [a]	2.80 [a]	0.3453	**0.0254**	0.5877
		Shave gel	3.29 [a]	3.41 [a]	3.22 [a]	0.4457	**0.0242**	0.8768
		Sunscreen	2.01 [a]	2.23 [a]	2.08 [a]	0.2012	**<0.0001**	0.6033
	Hair care	*Shampoo and conditioner*	2.81 [a]	3.08 [a]	3.08 [a]	0.0928	**<0.0001**	0.1797
		Hair styling	2.74 [a]	2.98 [a]	3.04 [a]	0.1166	**0.0002**	0.0747
Functional benefit	*Hydrate*		2.86 [b]	3.15 [a]	3.38 [a]	**0.0011**	**<0.0001**	0.9409
	Moisturizing		2.91 [b]	3.15 [a]	3.33 [a]	**0.0127**	**<0.0001**	0.5898
	Energizing		3.35 [b]	3.62 [a]	3.65 [a]	**0.0161**	**0.0461**	0.7230
	Refreshing		3.51 [a]	3.68 [a]	3.78 [a]	0.1325	**0.0254**	0.8058
	Gentle clean		3.19 [b]	3.44 [a]	3.62 [a]	**0.0099**	**0.0001**	0.7128
	Deep clean		3.07 [a]	3.25 [a]	3.34 [a]	0.1805	0.8566	0.5401
	Clean		3.42 [b]	3.66 [a]	3.62 [ab]	**0.0387**	**0.0179**	0.5336
	Sensitive skin		2.62 [b]	2.87 [a]	3.06 [a]	**0.0259**	**<0.0001**	0.3977
	Clear skin		2.75 [a]	2.98 [a]	3.07 [a]	0.0592	**0.0092**	0.3317
	Smooth		3.21 [b]	3.44 [a]	3.69 [a]	**0.0064**	**0.0347**	0.9116
	Softening		2.85 [c]	3.11 [b]	3.48 [a]	**0.0015**	**<0.0001**	0.8978
	Soothing		3.09 [b]	3.32 [a]	3.53 [a]	**0.0210**	**0.0009**	0.5777
	Restoring		2.91 [b]	3.18 [a]	3.29 [a]	**0.0122**	**0.0331**	0.5232
	Revitalizing		3.26 [b]	3.49 [a]	3.61 [a]	**0.0312**	**0.0034**	0.6490
	Cooling		3.04 [b]	3.26 [a]	3.40 [a]	**0.0366**	**0.0013**	0.7202
	Heating		2.40 [a]	2.46 [a]	2.83 [a]	0.0732	0.7785	0.3085
	Odor protection		3.20 [b]	3.47 [a]	3.55 [a]	**0.0235**	0.5510	0.5431

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.3a Overall Analysis of Conscientiousness Effect on Odorant Liking Scores and Net Average Emotion Responses across 5 Odorant Samples Rated by Consumers who had a Different Conscientiousness Level

Response		Level		p-value		
		Moderate (n=148)	High (n=92)	Level	Sample	Interaction
Hedonic	Odorant liking	6.45 ^{ns}	6.41 ^{ns}	0.8081	**<0.0001**	0.5876
Emotion series	*Pleasant feeling*	-1.34 ^{ns}	-1.00 ^{ns}	0.8616	**0.0008**	0.5471
	Sensuality	4.71 ^{ns}	1.71 ^{ns}	0.1415	**0.0008**	0.4387
	Unpleasant feeling	0.17 ^{ns}	1.45 ^{ns}	0.4523	**<0.0001**	0.2650
	Relaxation	-3.20 ^{ns}	-5.65 ^{ns}	0.2769	**<0.0001**	0.9627
	Sensory pleasure	5.06 ^{ns}	2.50 ^{ns}	0.1373	0.0633	0.5257
	Refreshment	6.77 ^{ns}	7.27 ^{ns}	0.8160	**<0.0001**	0.5706

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.3b Overall Analysis of Conscientiousness Effect on Average Level of Sensory and Consumer Terms Associated with Five Odorant Samples and Use Occasion Rated by Consumers who had a Different Conscientiousness Level

Response			Level		p-value		
			Moderate (n=148)	High (n=92)	Level	Sample	Interaction
Sensory and consumer terms	*Overall strength*		3.44 [a]	3.46 [a]	0.8486	**<0.0001**	0.8500
	Bold		3.33 [a]	3.26 [a]	0.4119	**<0.0001**	0.4400
	Heavy		2.97 [a]	2.86 [a]	0.2038	**<0.0001**	0.7800
	Modern		3.23 [a]	3.22 [a]	0.8542	**0.0025**	0.7700
	Clean		3.50 [a]	3.63 [a]	0.1649	**<0.0001**	0.6948
	Cool		3.19 [a]	3.15 [a]	0.6575	**<0.0001**	0.9500
	Crisp		3.23 [a]	3.23 [a]	0.9216	**<0.0001**	0.3700
	Fresh		3.42 [a]	3.49 [a]	0.4429	**<0.0001**	0.5100
	Harmony		3.00 [a]	2.89 [a]	0.2662	**<0.0001**	0.8000
	Familiarity		3.07 [a]	3.20 [a]	0.1945	**0.0018**	0.1500
	Natural		3.00 [a]	2.85 [a]	0.1157	**<0.0001**	0.9000
	Pleasing opposite sex		3.37 [a]	3.34 [a]	0.7216	**0.0044**	0.7300
	Distinctive		3.44 [a]	3.36 [a]	0.3572	0.2320	0.8800
	European		2.90 [a]	2.74 [a]	0.0983	0.2113	0.5300
	Asian/Oriental		2.05 [a]	1.86 [b]	**0.0383**	0.1044	0.9800
	Masculine		3.55 [a]	3.55 [a]	0.9670	**<0.0001**	0.7700
	Feminine		2.09 [a]	1.99 [a]	0.3076	**<0.0001**	**0.0200**
Use occasion	Time	Day	3.19 [a]	3.18 [a]	0.9523	**<0.0001**	0.5300
		Night	3.28 [a]	3.29 [a]	0.9257	0.1295	0.4841
		Anytime	3.15 [a]	3.14 [a]	0.9826	**0.0010**	0.6060
	Season	Spring	3.46 [a]	3.48 [a]	0.8864	**<0.0001**	0.2202
		Summer	3.43 [a]	3.45 [a]	0.7969	**<0.0001**	0.5607
		Fall	3.45 [a]	3.47 [a]	0.8604	0.1307	0.3201
		Winter	3.37 [a]	3.37 [a]	0.9764	0.0523	0.5461
	Activity	Sports	2.74 [a]	2.72 [a]	0.8267	**0.0067**	0.9216
		Outdoor	2.73 [a]	2.82 [a]	0.4808	**0.0312**	0.8259
		Formal	3.20 [a]	3.20 [a]	0.9670	**0.0066**	0.7421
		Casual	3.36 [a]	3.38 [a]	0.8622	**0.0008**	0.9293

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.3c Overall Analysis of Conscientiousness Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits of Five Odorant Samples Rated by Consumers who had a Different Conscientiousness Level

Response			Level		p-value		
			Moderate (n=148)	High (n=92)	Level	Sample	Interaction
Personal care	Body care	*All-in-one*	3.41 [a]	3.42 [a]	0.9625	**0.0001**	0.7738
		Body wash	3.65 [a]	3.70 [a]	0.5926	**<0.0001**	0.9224
		Body lotion	3.19 [a]	3.16 [a]	0.7285	**<0.0001**	0.9879
	Facial care	*Facial cleanser*	2.89 [a]	2.96 [a]	0.5650	**<0.0001**	0.7972
		Facial cream	3.31 [a]	3.42 [a]	0.3226	**0.0180**	0.8656
		Astringent	2.85 [a]	2.84 [a]	0.9076	**0.0006**	0.2409
		Shave gel	3.32 [a]	3.42 [a]	0.3821	**0.0015**	0.9369
		Sunscreen	2.25 [a]	1.99 [b]	**0.0272**	**<0.0001**	0.8512
	Hair care	*Shampoo and conditioner*	3.00 [a]	3.00 [a]	0.9666	**<0.0001**	0.7817
		Hair styling	2.89 [a]	2.96 [a]	0.5648	**<0.0001**	0.8407
Functional benefit	*Hydrate*		3.09 [a]	3.07 [a]	0.8877	**<0.0001**	0.2844
	Moisturizing		3.09 [a]	3.10 [a]	0.9419	**<0.0001**	0.3881
	Energizing		3.51 [a]	3.60 [a]	0.3265	**<0.0001**	0.4680
	Refreshing		3.60 [a]	3.69 [a]	0.3198	**<0.0001**	0.6514
	Gentle clean		3.37 [a]	3.39 [a]	0.8202	**<0.0001**	0.6430
	Deep clean		3.18 [a]	3.24 [a]	0.5760	0.2977	0.5794
	Clean		3.52 [a]	3.69 [a]	0.0578	**<0.0001**	0.9137
	Sensitive skin		2.83 [a]	2.78 [a]	0.6468	**<0.0001**	**0.0374**
	Clear skin		2.90 [a]	2.95 [a]	0.6613	**<0.0001**	0.2478
	Smooth		3.38 [a]	3.42 [a]	0.7043	**0.0001**	0.3040
	Softening		3.04 [a]	3.10 [a]	0.5936	**<0.0001**	0.2141
	Soothing		3.26 [a]	3.27 [a]	0.9127	**<0.0001**	0.2638
	Restoring		3.14 [a]	3.06 [a]	0.3748	**0.0042**	0.0656
	Revitalizing		3.41 [a]	3.47 [a]	0.5603	**0.0007**	0.6034
	Cooling		3.21 [a]	3.22 [a]	0.9151	**<0.0001**	0.7477
	Heating		2.58 [a]	2.30 [b]	**0.0036**	0.1549	0.2113
	Odor protection		3.32 [b]	3.52 [a]	**0.0364**	**0.0196**	0.2066

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.4a Overall Analysis of Extroversion Effect on Odorant Liking Scores and Net Average Emotion Responses across 5 Odorant Samples Rated by Consumers who had a Different Extroversion Level

Response		Level		p-value		
		Low-Moderate (n=131)	High-Very High (n=109)	Level	Sample	Interaction
Hedonic	Odorant liking	6.27 [b]	6.64 [a]	**0.0100**	**<0.0001**	0.1700
Emotion series	*Pleasant feeling*	-1.92 [a]	-0.36 [a]	0.4100	**0.0000**	0.5600
	Sensuality	2.26 [a]	5.13 [a]	0.1500	**0.0000**	0.5500
	Unpleasant feeling	1.97 [a]	-0.91 [a]	0.0800	**<0.0001**	0.6000
	Relaxation	-6.06 [b]	-1.83 [a]	**0.0500**	**<0.0001**	0.3800
	Sensory pleasure	3.56 [a]	4.70 [a]	0.5000	0.0700	0.7500
	Refreshment	7.09 [a]	6.81 [a]	0.8900	**<0.0001**	0.0800

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.4b Overall Analysis of Extroversion Effect on Average Level of Sensory Consumer Terms Associated with Five Odorant Samples and Use Occasion Rated by Consumers who had a Different Extroversion Level

Response			Level		p-value		
			Low-Moderate (n=131)	High-Very High (n=109)	Level	Sample	Interaction
Sensory and consumer terms	*Overall strength*		3.32 [b]	3.60 [a]	**0.0000**	**<0.0001**	0.3600
	Bold		3.20 [b]	3.42 [a]	**0.0100**	**<0.0001**	0.5900
	Heavy		2.85 [b]	3.02 [a]	**0.0400**	**<0.0001**	0.3400
	Modern		3.11 [b]	3.36 [a]	**0.0000**	**0.0000**	0.1400
	Clean		3.46 [b]	3.67 [a]	**0.0169**	**<0.0001**	**0.0159**
	Cool		3.05 [b]	3.32 [a]	**0.0000**	**<0.0001**	0.0900
	Crisp		3.14 [b]	3.34 [a]	**0.0300**	**<0.0001**	0.0800
	Fresh		3.33 [b]	3.59 [a]	**0.0000**	**<0.0001**	**0.0200**
	Harmony		2.82 [b]	3.12 [a]	**0.0000**	**<0.0001**	**0.0200**
	Familiarity		3.05 [a]	3.21 [a]	0.0900	**0.0100**	0.8400
	Natural		2.79 [b]	3.12 [a]	**0.0000**	**<0.0001**	0.1100
	Pleasing opposite sex		3.20 [b]	3.54 [a]	**0.0000**	**0.0000**	0.1500
	Distinctive		3.30 [b]	3.54 [a]	**0.0100**	0.2300	0.8500
	European		2.80 [a]	2.88 [a]	0.3800	0.1800	0.4800
	Asian/Oriental		1.93 [a]	2.03 [a]	0.2800	0.1200	0.5400
	Masculine		3.46 [b]	3.66 [a]	**0.0300**	**<0.0001**	0.6300
	Feminine		2.03 [a]	2.08 [a]	0.6500	**<0.0001**	0.3900
Use occasion	Time	Day	3.01 [b]	3.39 [a]	**0.0000**	**<0.0001**	0.5500
		Night	3.12 [b]	3.47 [a]	**0.0000**	0.0700	0.3100
		Anytime	2.99 [b]	3.33 [a]	**0.0000**	**0.0000**	0.8000
	Season	Spring	3.42 [a]	3.53 [a]	0.2600	**<0.0001**	0.3400
		Summer	3.40 [a]	3.48 [a]	0.4000	**<0.0001**	0.3500
		Fall	3.39 [a]	3.54 [a]	0.1200	0.0700	0.0800
		Winter	3.29 [a]	3.47 [a]	**0.0500**	**0.0300**	0.4900
	Activity	Sports	2.62 [b]	2.88 [a]	**0.0300**	**0.0000**	0.3700
		Outdoor	2.62 [b]	2.93 [a]	**0.0100**	**0.0200**	0.3300
		Formal	3.05 [b]	3.38 [a]	**0.0000**	**0.0000**	0.7500
		Casual	3.21 [b]	3.56 [a]	**0.0000**	**0.0000**	0.3100

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.4c Overall Analysis of Extroversion Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits of Five Odorant Samples Rated by Consumers who had a Different Extroversion Level

Response			Level		p-value		
			Low-Moderate (n=131)	High-Very High (n=109)	Level	Sample	Interaction
Personal care	Body care	*All-in-one*	3.37 [a]	3.48 [a]	0.2600	**<0.0001**	0.4500
		Body wash	3.60 [a]	3.74 [a]	0.1300	**<0.0001**	0.3000
		Body lotion	3.09 [b]	3.30 [a]	**0.0400**	**<0.0001**	0.1100
	Facial care	*Facial cleanser*	2.85 [a]	3.00 [a]	0.1600	**<0.0001**	0.4200
		Facial cream	3.31 [a]	3.41 [a]	0.3200	**0.0300**	0.1600
		Astringent	2.81 [a]	2.90 [a]	0.3900	**0.0000**	0.2100
		Shave gel	3.33 [a]	3.39 [a]	0.5600	**0.0000**	0.3900
		Sunscreen	2.04 [b]	2.29 [a]	**0.0300**	**<0.0001**	0.5200
	Hair care	*Shampoo and conditioner*	2.89 [b]	3.14 [a]	**0.0200**	**<0.0001**	0.1200
		Hair styling	2.82 [a]	3.03 [a]	0.0600	**<0.0001**	0.5300
Functional benefit	Hydrate		2.95 [b]	3.23 [a]	**0.0011**	**<0.0001**	0.7402
	Moisturizing		2.98 [b]	3.22 [a]	**0.0062**	**<0.0001**	0.8553
	Energizing		3.49 [a]	3.61 [a]	0.1430	**<0.0001**	**0.0260**
	Refreshing		3.57 [a]	3.72 [a]	0.0843	**0.0002**	0.0662
	Gentle clean		3.29 [b]	3.49 [a]	**0.0250**	**<0.0001**	0.0650
	Deep clean		3.09 [b]	3.34 [a]	**0.0114**	0.2079	0.3519
	Clean		3.51 [a]	3.67 [a]	0.0689	**<0.0001**	0.1662
	Sensitive skin		2.70 [b]	2.95 [a]	**0.0121**	**<0.0001**	0.2967
	Clear skin		2.78 [b]	3.09 [a]	**0.0008**	**<0.0001**	0.3132
	Smooth		3.26 [b]	3.56 [a]	**0.0006**	**<0.0001**	0.0676
	Softening		2.92 [b]	3.24 [a]	**0.0007**	**<0.0001**	0.6664
	Soothing		3.14 [b]	3.42 [a]	**0.0018**	**<0.0001**	0.4011
	Restoring		3.02 [b]	3.21 [a]	**0.0399**	**0.0032**	0.2054
	Revitalizing		3.34 [b]	3.55 [a]	**0.0194**	**0.0003**	0.2468
	Cooling		3.13 [a]	3.30 [a]	0.0604	**<0.0001**	0.2142
	Heating		2.39 [b]	2.58 [a]	**0.0482**	0.1768	0.7623
	Odor protection		3.32 [a]	3.49 [a]	0.0655	**0.0062**	0.8391

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.5a Overall Analysis of Agreeableness Effect on Odorant Liking Scores and Net Average Emotion Responses across 5 Odorant Samples Rated by Consumers who had a Different Agreeableness Level

Response		Level		p-value		
		Moderate (n=188)	High (n=52)	Level	Sample	Interaction
Hedonic	Odorant liking	6.40 ^{ns}	6.56 ^{ns}	0.3649	**<0.0001**	0.4482
Emotion series	*Pleasant feeling*	-1.50 ^{ns}	-0.17 ^{ns}	0.5599	**0.0308**	0.5713
	Sensuality	4.42 ^{ns}	0.47 ^{ns}	0.1007	**0.0021**	0.2288
	Unpleasant feeling	0.79 ^{ns}	0.19 ^{ns}	0.7661	**0.0023**	0.9155
	Relaxation	-4.03 ^{ns}	-4.54 ^{ns}	0.8472	**0.0017**	0.7319
	Sensory pleasure	4.83 ^{ns}	1.35 ^{ns}	0.0868	0.2179	0.5956
	Refreshment	7.46 ^{ns}	5.17 ^{ns}	0.3673	**0.0001**	0.2569

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.5b Overall Analysis of Agreeableness Effect on Average Level of Sensory and Consumer Terms Associated with Five Odorant Samples and Use Occasion Rated by Consumers who had a Different Agreeableness Level

Response			Level		p-value		
			Moderate (n=188)	High (n=52)	Level	Sample	Interaction
Sensory and consumer terms	*Overall strength*		3.42 [a]	3.55 [a]	0.1979	**<0.0001**	0.8618
	Bold		3.29 [a]	3.35 [a]	0.5476	**<0.0001**	0.4929
	Heavy		2.93 [a]	2.94 [a]	0.8665	**<0.0001**	0.9449
	Modern		3.19 [a]	3.35 [a]	0.1282	0.1133	**0.0029**
	Clean		3.50 [a]	3.75 [a]	**0.0163**	**<0.0001**	0.3204
	Cool		3.11 [b]	3.38 [a]	**0.0190**	**0.0157**	0.4005
	Crisp		3.17 [b]	3.43 [a]	**0.0177**	**0.0042**	0.6506
	Fresh		3.40 [b]	3.63 [a]	**0.0236**	**<0.0001**	0.8140
	Harmony		2.94 [a]	3.00 [a]	0.5917	**0.0008**	0.2002
	Familiarity		3.12 [a]	3.12 [a]	0.9978	0.1491	0.9618
	Natural		2.95 [a]	2.91 [a]	0.6911	**<0.0001**	0.1649
	Pleasing opposite sex		3.34 [a]	3.43 [a]	0.3719	0.0730	0.0757
	Distinctive		3.41 [a]	3.40 [a]	0.9350	0.3880	0.4211
	European		2.83 [a]	2.86 [a]	0.8263	0.3170	**0.0202**
	Asian/Oriental		1.99 [a]	1.91 [a]	0.4556	**0.0264**	0.2171
	Masculine		3.53 [a]	3.63 [a]	0.4114	**<0.0001**	0.5574
	Feminine		2.07 [a]	1.98 [a]	0.4083	**<0.0001**	0.5605
Use occasion	Time	Day	3.18 [a]	3.20 [a]	0.8408	**0.0002**	0.2249
		Night	3.30 [a]	3.22 [a]	0.6107	0.2089	0.0677
		Anytime	3.13 [a]	3.20 [a]	0.5741	**0.0028**	0.2408
	Season	Spring	3.43 [a]	3.60 [a]	0.1218	**<0.0001**	0.3629
		Summer	3.41 [a]	3.53 [a]	0.2536	**<0.0001**	0.4798
		Fall	3.42 [a]	3.58 [a]	0.1876	0.1257	0.7355
		Winter	3.35 [a]	3.43 [a]	0.4670	0.1982	0.7024
	Activity	Sports	2.73 [a]	2.77 [a]	0.7858	0.1798	0.4996
		Outdoor	2.73 [a]	2.88 [a]	0.3029	0.1783	0.4881
		Formal	3.20 [a]	3.22 [a]	0.8659	**0.0253**	**0.0121**
		Casual	3.37 [a]	3.38 [a]	0.8932	**0.0081**	0.3940

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.5c Overall Analysis of Agreeableness Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits of Five Odorant Samples Rated by Consumers who had a Different Agreeableness Level

Response			Level		p-value		
			Moderate (n=188)	High (n=52)	Level	Sample	Interaction
Personal care	Body care	*All-in-one*	3.39 [a]	3.53 [ns]	0.2327	**0.0051**	0.4031
		Body wash	3.65 [a]	3.73 [ns]	0.4369	**0.0002**	0.3301
		Body lotion	3.17 [a]	3.20 [ns]	0.8098	**<0.0001**	0.1042
	Facial care	*Facial cleanser*	2.88 [a]	3.05 [ns]	0.1982	**0.0007**	0.9879
		Facial cream	3.34 [a]	3.41 [ns]	0.5491	0.1648	0.4637
		Astringent	2.85 [a]	2.83 [ns]	0.8861	**0.0426**	0.1548
		Shave gel	3.34 [a]	3.44 [ns]	0.4290	**0.0249**	0.3622
		Sunscreen	2.17 [a]	2.08 [ns]	0.5252	**<0.0001**	0.8905
	Hair care	*Shampoo and conditioner*	2.97 [a]	3.12 [ns]	0.2704	**<0.0001**	0.1441
		Hair styling	2.89 [a]	2.99 [ns]	0.4745	**<0.0001**	0.8475
Functional benefit	*Hydrate*		3.04 [b]	3.25 [a]	**0.0448**	**<0.0001**	0.2854
	Moisturizing		3.05 [b]	3.26 [a]	**0.0421**	**<0.0001**	0.4396
	Energizing		3.52 [a]	3.64 [a]	0.2372	**0.0033**	0.6264
	Refreshing		3.59 [a]	3.78 [a]	0.0632	**0.0105**	0.5593
	Gentle clean		3.32 [b]	3.60 [a]	**0.0081**	**<0.0001**	0.2745
	Deep clean		3.16 [a]	3.36 [a]	0.0862	0.8100	0.5960
	Clean		3.54 [a]	3.74 [a]	0.0598	**<0.0001**	0.3120
	Sensitive skin		2.77 [a]	2.98 [a]	0.0753	**<0.0001**	0.2439
	Clear skin		2.85 [b]	3.18 [a]	**0.0041**	**<0.0001**	0.8222
	Smooth		3.34 [b]	3.59 [a]	**0.0165**	**0.0005**	0.2393
	Softening		3.01 [b]	3.25 [a]	**0.0486**	**<0.0001**	0.7954
	Soothing		3.21 [b]	3.47 [a]	**0.0232**	**<0.0001**	0.6757
	Restoring		3.06 [b]	3.28 [a]	**0.0484**	0.0895	0.3663
	Revitalizing		3.40 [a]	3.57 [a]	0.1171	**0.0096**	0.5308
	Cooling		3.17 [a]	3.35 [a]	0.0879	**0.0005**	0.1665
	Heating		2.46 [a]	2.54 [a]	0.4799	0.5142	0.7195
	Odor protection		3.34 [b]	3.60 [a]	**0.0286**	**0.0410**	0.1786

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.6a Overall Analysis of Neuroticism Effect on Net Average Emotion Ratings, Odorant Liking Score across 5 Odorant Samples Rated by Consumers who had a Different Neuroticism Level

Response		Level		p-value		
		Low-Moderate (n=181)	High (n=59)	Level	Sample	Interaction
Hedonic	Odorant liking	6.40 [ns]	6.55 [ns]	0.3460	**<0.0001**	0.1755
Emotion series	*Pleasant feeling*	-2.13 [ns]	1.61 [ns]	0.0843	**0.0116**	0.6020
	Sensuality	3.20 [ns]	4.67 [ns]	0.5236	**0.0025**	0.3756
	Unpleasant feeling	1.58 [ns]	-2.17 [ns]	0.0501	**0.0018**	0.8739
	Relaxation	-5.09 [ns]	-1.23 [ns]	0.1289	**0.0012**	0.4063
	Sensory pleasure	4.68 [ns]	2.22 [ns]	0.2068	0.2956	0.6874
	Refreshment	7.23 [ns]	6.14 [ns]	0.6538	**<0.0001**	0.4266

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Consumers evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.6b Overall Analysis of Neuroticism Effect on Average Level of Sensory and Consumer Terms Associated with Five Odorant Samples and Use Occasion Rated by Consumers who had a Different Neuroticism Level

Response			Level		p-value		
			Low-Moderate (n=181)	High (n=59)	Level	Sample	Interaction
Sensory and consumer terms	*Overall strength*		3.46 ^{ns}	3.41 ^{ns}	0.6423	**<0.0001**	0.7027
	Bold		3.32 ^{ns}	3.26 ^{ns}	0.5226	**<0.0001**	0.5237
	Heavy		2.97 ^{ns}	2.81 ^{ns}	0.1073	**<0.0001**	0.5369
	Modern		3.23 ^{ns}	3.22 ^{ns}	0.9128	**0.0268**	0.4292
	Clean		3.52 ^{ns}	3.66 ^{ns}	0.1750	**<0.0001**	0.9777
	Cool		3.13 ^{ns}	3.31 ^{ns}	0.0827	**0.0019**	0.7936
	Crisp		3.19 ^{ns}	3.34 ^{ns}	0.1758	**0.0016**	0.9949
	Fresh		3.41 ^{ns}	3.56 ^{ns}	0.1336	**<0.0001**	0.9151
	Harmony		2.93 ^{ns}	3.03 ^{ns}	0.3368	**0.0010**	0.7083
	Familiarity		3.10 ^{ns}	3.21 ^{ns}	0.3011	**0.0104**	0.8492
	Natural		2.97 ^{ns}	2.86 ^{ns}	0.2854	**0.0007**	0.6837
	Pleasing opposite sex		3.34 ^{ns}	3.41 ^{ns}	0.4811	**0.0423**	0.3153
	Distinctive		3.44 ^{ns}	3.30 ^{ns}	0.1623	0.3909	0.8100
	European		2.84 ^{ns}	2.84 ^{ns}	0.9770	0.0787	0.2214
	Asian/Oriental		1.98 ^{ns}	1.97 ^{ns}	0.8955	0.0815	0.2698
	Masculine		3.57 ^{ns}	3.51 ^{ns}	0.5980	**<0.0001**	0.9547
	Feminine		2.04 ^{ns}	2.10 ^{ns}	0.5667	**<0.0001**	0.2038
Use occasion	Time	Day	3.18 ^{ns}	3.19 ^{ns}	0.9679	**<0.0001**	0.7073
		Night	3.28 ^{ns}	3.29 ^{ns}	0.9371	0.2232	0.6147
		Anytime	3.13 ^{ns}	3.20 ^{ns}	0.5685	**0.0007**	0.9064
	Season	Spring	3.45 ^{ns}	3.53 ^{ns}	0.4614	**<0.0001**	0.5439
		Summer	3.42 ^{ns}	3.48 ^{ns}	0.5363	**<0.0001**	0.7020
		Fall	3.43 ^{ns}	3.53 ^{ns}	0.3694	0.2376	0.8358
		Winter	3.34 ^{ns}	3.46 ^{ns}	0.2675	0.2503	0.3971
	Activity	Sports	2.72 ^{ns}	2.78 ^{ns}	0.6672	**0.0349**	0.7074
		Outdoor	2.73 ^{ns}	2.87 ^{ns}	0.2733	0.1751	0.6400
		Formal	3.18 ^{ns}	3.27 ^{ns}	0.4832	**0.0258**	0.7217
		Casual	3.35 ^{ns}	3.42 ^{ns}	0.6157	**0.0040**	0.9902

* Association level of sensory and consumer terms with each odorant were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. The agreement on use occasion of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Supplementary Table 6.6c Overall Analysis of Neuroticism Effect on Possible Application in Personal Care Products and Expectation of Functional Benefits of Five Odorant Samples Rated by Consumers who had a Different Neuroticism Level

Response			Level		p-value		
			Low-Moderate (n=181)	High (n=59)	Level	Sample	Interaction
Personal care	Body care	*All-in-one*	3.39 [a]	3.51 [a]	0.2634	**0.0002**	0.7633
		Body wash	3.67 [a]	3.64 [a]	0.7774	**<0.0001**	0.3843
		Body lotion	3.20 [a]	3.13 [a]	0.5546	**<0.0001**	0.4561
	Facial care	*Facial cleanser*	2.92 [a]	2.91 [a]	0.9437	**0.0001**	0.6265
		Facial cream	3.35 [a]	3.36 [a]	0.9467	**0.0203**	0.2812
		Astringent	2.82 [a]	2.95 [a]	0.2687	**0.0063**	0.1510
		Shave gel	3.36 [a]	3.37 [a]	0.9337	**0.0011**	0.7093
		Sunscreen	2.14 [a]	2.17 [a]	0.8377	**<0.0001**	0.4345
	Hair care	*Shampoo and conditioner*	3.01 [a]	2.98 [a]	0.8576	**<0.0001**	0.8906
		Hair styling	2.91 [a]	2.94 [a]	0.8362	**0.0001**	0.9908
Functional benefit	*Hydrate*		3.08 [a]	3.10 [a]	0.7917	**<0.0001**	0.8202
	Moisturizing		3.09 [a]	3.09 [a]	0.9985	**<0.0001**	0.5988
	Energizing		3.54 [a]	3.56 [a]	0.8223	**<0.0001**	0.6215
	Refreshing		3.62 [a]	3.68 [a]	0.5693	**0.0002**	0.8243
	Gentle clean		3.36 [a]	3.44 [a]	0.4102	**<0.0001**	0.7707
	Deep clean		3.17 [a]	3.32 [a]	0.1769	0.3744	0.9408
	Clean		3.55 [a]	3.71 [a]	0.1005	**<0.0001**	0.9905
	Sensitive skin		2.75 [b]	3.00 [a]	**0.0318**	**<0.0001**	0.4443
	Clear skin		2.87 [a]	3.06 [a]	0.0963	**<0.0001**	0.9503
	Smooth		3.36 [a]	3.50 [a]	0.1596	**0.0029**	0.3833
	Softening		3.02 [a]	3.20 [a]	0.1025	**<0.0001**	0.6574
	Soothing		3.22 [a]	3.42 [a]	0.0632	**0.0005**	0.8451
	Restoring		3.09 [a]	3.17 [a]	0.4602	0.0846	0.4138
	Revitalizing		3.42 [a]	3.47 [a]	0.6695	**0.0012**	0.9105
	Cooling		3.17 [a]	3.32 [a]	0.1748	**<0.0001**	0.6195
	Heating		2.47 [a]	2.48 [a]	0.8932	0.5159	0.7441
	Odor protection		3.35 [a]	3.55 [a]	0.0697	0.1796	0.5425

* The agreement on possible application in personal care products and expectation of functional benefits of each odorant were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree.

** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. **Bolded** p-values represented significant difference ($p<0.05$).

Chapter 7 - Influence of Pleasant Odorants on Subjective Responses: the Congruency of Odorants and Olfactory Responses

Abstract

Consumers often expect a personal care product to provide additional benefits and induce positive emotional experiences in addition to providing a primary property (i.e., enhancing fragrance in perfume or odor masking odor in deodorants). Scent is now used as a major component to reinforce marketing elements. The objective of study was to investigate the relationship between the odorants and their olfactory effects toward consumer responses.

Two hundred forty participants evaluated five masculine odorants for liking, impact on emotion, potential application in personal care products, expected functional benefits, and term association. Results demonstrated that olfactory liking positively correlated to most olfactory responses. A pleasant smell influenced a person's thoughts and feelings reflecting a positive emotional experience (*pleasant feeling*, *refreshment*, *sensory pleasure*, and *sensuality*). Overall liking also led to that fragrance being viewed as appropriate for most occasions, appropriate for most personal care products, and raised the expectation of functional benefit.

Results demonstrated that the most liked odorants were associated with sensory and consumer terms such as *clean*, *crisp*, *fresh*, and *natural*. In contrast, participants associated the least liked odorants with terms such as *heavy* and *bold*. Terms related to gender specificity (*masculine* and *feminine*) did not seem to influence or be associated with participant olfactory liking.

Introduction

Consumers often expect personal care products, including fragrances, to deliver additional benefits (e.g., mood enhancement, enjoyable experience, and functional benefits) more than just a primary property (e.g., enhancing or masking body odor) (John et al., 2006; Roberts et al., 2009. In addition, consumers are more concerned with their personal appearance, social interaction, and awareness of others which can be driven by olfactory cues (Stockhorst & Pietrowsky, 2004; Aglioti & Pazzaglia, 2011). Personal appearance and grooming have become more important among consumers leading to the growth of fragrance and personal care markets which globally reached about $96.5 billion in 2011 (Tyrimou, 2012).

Originally, personal care manufacturers often used fragrance to mask unpleasant odors caused by product formulation. However, manufacturers now use fragrance as reinforcement and support for marketing elements (brand, product, packaging, advertising message, etc.) to promote a total sensorial package (Milotic, 2003; Gleason-Allured, 2010; Falk & Penning, 2012; Porcherot, Delplanque, Planchais, Gaudreau, Accolla, & Cayeux, 2012).

Consumer's initial purchase decisions for personal care products are influenced primarily by fragrance appreciation and expectations for product efficacy or intended function (Schroiff, 1991; Milotic, 2003; Gleason-Allured, 2008; Tanner, 2008; Gleason-Allured, 2010; Gleason-Allured & Grabenhofer, 2010; Grubow & Kastner, 2011). For example, consumers explore new products in the market by searching for a brand or a package that is visually attractive to them, then smelling the product, and then deciding whether they want to purchase or continue searching for a different product (Tanner, 2008; Penning, 2011; Harper & Burns, 2012).

Scientists believe that the desire and need for emotional connection, sensorial experience, and pleasure influence whether a person appreciates odorants (Gleason-Allured, 2008). A product containing a 'good' fragrance tends to be successful since the fragrance creates and

enhances the consumption experience ob consumers leading directly to a repeat usage and brand loyalty (Gleason-Allured & Grabenhofer, 2010; Penning, 2011; Falk & Penning, 2012).

Understanding composition and function of each odor in a fragrance would aid product developer to create a complex fragrance blend that enhances product efficiency and generates an emotional connection during the consumption experience (Gregory, 2012). Additionally, an understanding of odor descriptors or terms associated with odorants is essential for product developers because it provides a standard communication among researchers, retailers and consumers (Jellinek, 1992; Zarzo & Stanton, 2009; Donna, 2009).

Considerable literature has reported on the functional properties of scents, impact of scent in human perceptions (physiological and psychological effects), or functionality benefits (Jellinek, 1951; Jellinek, 1997; Zarzo & Stanton, 2009). Thus a product's scent should have olfactory cues or signals reinforcing, complimenting, or initiating consumer expectation to the promise or benefit of a product (Deliza & MacFie, 1996; Gleason-Allured, 2008; Ruffolo, 2011; Falk & Penning, 2012; Gregory, 2012). In other words, the scents should provide an instant impact to consumers by raising expectations of product performance and creating a message that the product does really work (John et al., 2006; Herman, 2012). Once the expectation reaches parity to perceived benefits, consumers are likely to become satisfied with that particular product leading to product repurchase and loyalty (Deliza & MacFie, 1996).

Because personality had little effect on the impact of the fragrances (prior chapters), the question of whether acceptance of the fragrances was the driving factor in differentiating fragrance effects. Therefore the objectives in this study were to (1) investigate consumer olfactory acceptance and (2) investigate the effect of odorants on olfactory responses: emotional

experience, term association, potential use occasion, application in personal care products, and expectation of functional benefit.

Materials and Methods

Odorant Selection and Preparation

Odorants Selection

To reduce the variability of the gender association category of fragrance, this study focused on only the masculine odorants. Three personal care researchers selected five odorants representing a wide spectrum of masculine fragrances. The samples had olfactory characteristics that smelled different from each other. The selected odorants were evaluated by a fragrance expert for sensory profile which was presented in the table below (Table 7.1).

Table 7.1 Odorant Samples with Classification and Description

Odorant type	Sample	Edwards' classification	Description
Odorant purposely made for personal care product	112	Mossy woods - Citrus	Chypré: moss, citrus, floral, woody
	357	Soft floral - Green	Soapy, vanilla, musk, rose
	413	Floral-Citrus	Lime, violet
	958	Oriental-Floral	Lavender, coconut, anise, musk
Commercial cologne	504	Aromatic	Fougère: geranium, cedar, lime, musk

Sample Preparation

A cotton swab (Qtips®, Uniliver, USA) was filled with a 0.5 mL of an odorant using disposable 1 mL tuberculin syringe (sterilized) (Fisher Scientific Inc., PA). Then, the scented cotton swab was placed- the swab side down- in an amber vial (Fisher Scientific Inc., PA) labeled with 3-digit code. Then, each bottle was placed individually in a clear bubble bag

(Staple®, USA) to protect damage for delivery. A label having a letter "A" was placed onto a bag to indicate the first sample order, whereas B, C, D, and E represented evaluation order from 2nd to 5th. All five samples were packed in a box and sent out to each participant using United States Postal Office (USPS). The package was expected to be delivered within 1-3 business days.

In addition, the study was conducted when the average temperature across the country was at the range of 42-56 F° (National Oceanic and Atmospheric Administration [NCDC], 2012). This information suggested that the fragrance samples had not deteriorated during transport.

Consumer Test

One hundred fifty male and 150 female participants, age of 18-49 years, were randomly selected during the personality pattern classification participated in this study. The participant completed the test via the internet using a Home Use Test (HUT) method.

Participants

A total of 976 participants across the United States completed the big-five personality survey and claimed to be male who uses colognes or fragranced personal care products, or female who likes the smell of cologne, personal care products on men. The screening survey and big-five inventory for personality classification are showed in Appendix A and B, respectively.

Participants were, then, divided into subcategories based on demographic information (gender and age [18-25, 26-35, and 36-49]) and personality patterns (Chapter 4). Three-hundred participants were selected (Fifty participants from 6 demographic groups [2 genders x 3 age groups]). The participants also represented 5 different personality patterns (55-73 participants per personality group).

Execution of Home Use Test via the Internet

Each participant received an email notifying them about the coming package to their address and providing the test schedule for 5 odorant samples. Participants were asked to evaluate a sample anytime within given 3-day at home, then they were asked to evaluate another sample on the next following days. The online-survey for each sample was only available on the specified dates. The test covered approximately 2 weeks for participants to complete.

On the evaluation day, participants were asked to log in to the website and register the sample code appearing on the label of the sample vial to access the survey. The procedure for consumer survey is addressed in the following section.

Questionnaires

- Emotion Questions and Modification

Researchers used the ScentMove^{TM} questionnaire (Porcherot et al., 2010) to measure emotional experience. The participants rated the pertinence of each of the six series of three feeling terms to describe their feelings before and immediately after smelling the odorant on a 10-cm linear scale ranging from "no feelings" to "very intense feelings". The emotion ratings were translated to numeric values from 0 to 100 to maximize the scale.

- Odorant Acceptance

Participants were asked to indicate how much they liked or disliked the smell of each odorant sample on a 9-point scale where 1 represented dislike extremely to 9 represented like extremely.

- Degree of Sensory and Consumer Terms Associated with an Odorant

A checklist consisted of an odor strength rating and sixteen sensory and consumer terms, were modified from previous studies and articles (Jellinek, 1992; Higuchi et al., 2004; Gleason-

Allured, 2008; Zarzo & Stanton, 2009; Falk & Penning, 2012; Lindqvist, 2012a; Porcherot et al., 2012), was used as evaluation material. The participants were asked to indicate association level of term toward an odorant using a numerical scale, ranging from 1 = not at all to 5 = extreme.

- Agreement/Disagreement on Use Occasion Statements

The participants were asked to identify the level of their agreement or disagreement on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) toward 11 different situations including time of the day, seasons, activities, and occasions. This question was developed and modified from Aarts (2003) and Rétiveau (2004). The question "If you are going to wear this cologne, when would you wear it?" was used to introduce each statement to participants.

- Agreement/Disagreement on Potential Application in Personal Care Products

Participants were asked to indicate how much they agree or disagree on an appropriateness of the scent to be incorporated in each of 10 personality categories on a 5-point Likert scale (1 = disagree strongly to 5 = agree strongly). The personal care categories modified from Wormuth, Scheringer, & Hungerbühler (2005).

- Agreement/Disagreement on Expectation of Functional Benefits

Participants were asked to determine if they have any expectation of functional benefit when they smell an odorant. A 5-point Likert scale (1 = disagree strongly, to 5 = agree strongly) was provided to participants to indicate their agreement/disagreement on 17 functional benefit.

Data analysis

Data Preparation for Emotion Dimensions

The emotion ratings prior to odorant evaluation were subtracted from the emotion ratings during the evaluation to reduce the impact of a persons' initial psychological state, before analyzing the data (Bhumiratana, 2010; Gibson, 2006).

Analysis of Significant Difference for the Variables Obtained from Participants

Each variable obtained from all participants were subjected to Analysis of Variance (AOV), using the GLIMMIX procedure at the 5% level of significance (SAS®), to determine if there is, at least, a significant difference on odorant samples. Mean separation tests (multiple t-tests) were carried out to compare the means if significant differences existed.

For each response variable category, average scores of five odorant samples were illustrated in bar charts with asterisk (*) representing a significant difference between participant groups ($p<0.05$).

Results and Discussion

At the end of study, 240 out of 300 participants completed the test and provided responses which were not doubtful or obvious faulty entries. The participants were distributed similarly for gender and personality categories. However, the ratio among participants in the age groups was unequal. Most of participants were aged between 26-49 years old (86%) and the rest were participants who aged between 18-25 years old (Table 7.2).

The previous studied demonstrated that participants from different gender, age, and personality group had similar olfactory responses (Chapter 5 and 6). Therefore, the whole data set was directly subjected to statistical analyses.

Table 7.2 Individual Difference Make-up of 240 Participants

Individual difference		Participants	
		(N)	Percent (%)
Gender	Male	123	51
	Female	117	49
Age group (year)	18-25	33	14
	26-35	101	42
	36-49	106	44
Personality pattern	Extreme personality	47	20
	Slightly extreme personality	43	18
	Slightly extreme and emotionally labile	47	20
	Emotionally ambivalent	43	18
	Emotionally ambivalent and labile	60	25

Odorant Liking of the Five Odorant Samples

The olfactory liking scores showed that all odorants were well accepted. The mean scores of all 5 odorant samples received above 6 points (like slightly) on a 9-point hedonic scale. Results demonstrated that participants liked sample 413 and 112 more than sample 958, 504, and 357 ($p<0.0001$) (Figure 7.1a).

Emotion Experiences of the Five Odorant Samples

Although, all five odorant samples received similar odorant acceptability score means ranging between 6-7, participants had different emotional profiles after smelling each odorant. This phenomenon is supported by the conclusion from King & Meiselman (2009) and Bhumiratana (2010) that similar acceptability ratings were not associated with similar emotion profiles and vice versa. In this study, all emotional terms except for sensory pleasure were found to be significantly different ($p<0.05$). Participants experienced more positive emotions (*pleasant feeling*, *sensuality*, *relaxation*, as well as *refreshment*) when they smelled odorant sample 413 and 112 (the most liked samples). In addition, those two odorants also decreased participants'

unpleasant feelings. In contrast, the least liked samples (958, 504, and 357) generally decreased positive emotions or had less emotion impact than the most liked samples (Figure 7.1b).

Pleasantness is the principal foundation of perception in emotion dimensions (Fontaine et al., 2007; Yeshurun & Sobel, 2010). Hence, pleasant odorants elicited positive emotions whereas unpleasant odors induced negative emotions of participants (Rétiveau, Chambers, & Miliken, 2004; Schiffman et al., 1995).

Association between Sensory& Consumer Terms and the Five Odorant Samples

Participants indicated different association levels of most terms toward different odorant samples ($p<0.05$) with the exception of the terms *distinctive*, *European*, and *Asian/Oriental.*

Participants highly associated most terms with sample 413 and 112 (the most liked samples). Both samples were perceived to be highly associated with terms, such as *modern*, *crisp*, *familiar*, *natural*, and *pleasing opposite sex* ($p<0.05$) (Figure 7.1c). In addition, participants highly associated odorant sample 413 with the terms *clean*, *fresh,* and *feminine* ($p<0.05$). Lindqvist (2012a) reported that participants associated *fresh* with their preferred odor. Participants also indicated that odorant 413 was less associated with terms such as *bold*, *heavy*, and *masculine* than the other samples.

Terms such as *bold*, *heavy*, and *European* were the terms consumers highly associated with the least liked samples (sample 504, 357, and 958). Those terms begin to differentiate samples on more than just terms associated with liking.

Results indicated that gender related terms (*masculinity* and *feminity*) seemed to be associated with samples independent of olfactory liking scores. For example, odorant sample 112 (a most liked sample) and 504 (a least liked sample) were highly associated with *masculine*, but another most liked sample (413) was more highly associated with *feminity* more than

masculinity. This conclusion is supported by Lindqvist (2012b) who found that commercial gender categorization of perfumes was not important to participants' perception. The finding also showed that gender association of odors demonstrated a continuum of overlapping odorant/perfumes (Jellinek, 1992; Zarzo, 2008; Zarzo & Stanton, 2009; Lindqvist, 2012a).

Use Occasion and Five Odorant Samples

Participants indicated that all five odorants are appropriate in most occasions ($p<0.05$) except for at night time and fall ($p>0.05$). The most liked samples (413 and 112) also were most likely to be most appropriate for most occasions. The agreement ratings of most use occasions were higher than neutral point (3.0) except for sport and outdoor activities, where the agreement ratings were below 3.0 (Figure 7.1d).

Results indicated that the least liked odorant samples (sample 958, 504, and 357) were less fit in all occasions than the most liked odorants. Penning (2011) found that participants felt more positive about odors where they liked the smell. In this study more pleasant odorants apparently elicited positive moods and likely influenced participants' decisions on the congruency of use occasion.

Possible Applications for Personal Care Products on the Five Odorant Samples

Agreement ratings on potential odorant application in personal care products were found to be different among the 5 samples ($p<0.05$). Participants indicated sample 413 and 112 (the most liked samples) were the most congruent in most personal care products (Figure 7.1e).

Results also indicated that participants gave higher agreement rating for incorporating any of the odorants in body care products (all-in-one, body wash, and body lotion) than in hair care and facial care products, respectively. Participants provided lower rating toward facial care products, especially sunscreen and astringent, probably because participants are accustomed to a

lightly scented product, which was generally used for masking the smell of ingredients (Falk & Penning, 2012). Participants clearly did not think that any of these odorants was appropriate in a sunscreen product as the agreement ratings were below the neutral point (3.0). This likely is related to the nature of sunscreen, which is perceived to be fragranced-free or have a simple scent (Hayden, 2009).

Expectation of Functional Benefits for the Five Odorant Samples

Results indicated that participants generally perceived all five odorants to be different in providing expectations of functional benefit ($p<0.0001$). However, participants perceived all five odorants to have the same potential for deep cleaning and heating properties ($p>0.05$)

Participants provided the highest agreement rating for expectations of functional benefits when they smelled sample 413 (the most liked odorant), followed by sample 112 (another most liked sample) that was expected to provide functional benefits slightly less than sample 413 (Figure 7.1f).

This phenomenon also can be explained by the impact of olfactory preference, when participants liked the smell, then they would think and feel positively to a particular product (Penning, 2011). Thus, the pleasant odorant positively influenced participants' expectations of functional benefit. This is a key finding since the idea that a fragrance "promotes" the expectation of functional benefit is a common marketing theme.

Figure 7.1 Average Responses Obtained from 240 Participants ([a] Odorant Liking, [b] Emotion Profile, [c] Term Associations, [d] Occasional Usage, [e] Potential Application in Personal Care Products, and [f] Expectation of Functional Benefit)

Conclusion

Results demonstrated that odorants used in this study generally were well accepted. However, these odorants provided a different emotion experience to participants: the most liked odorants increased positive emotions and decreased negative emotions more than the other odorants that received lower liking scores. In addition, results also demonstrated that the most liked odorants positively influence participants perceived use occasion, potential application in personal care products, and expectations of functional benefits.

A strong association of the most liked samples and the consumer terms such as *clean*, *cool*, *crisp, fresh*, and *natural* were found. In contrast, terms such as *heavy* and *bold* were highly associated with at least one of the least liked samples. The term *feminine* and *masculine* did not seem to be associated with the odorant liking.

References

Aarts, P. (2003). Fragrances with real impact. *Perfumer and Flavorist*, *28(5),* 34-49.

Aglioti, S.M., & Pazzaglia, M. (2011). Sounds and scents in (social) action. *Trends in Cognitive Science*, *15(2),* 47-55.

Barbalova, I. (2012, November). Do men really care about beauty? *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/consumers/men/176009851.html.

Bhumiratana, N., (2010). *The development of an emotion lexicon for the coffee drinking experience (Doctoral dissertation)*. Retrieved from http://krex.k-state.edu/dspace/handle/2097/7010.

Deliza, R., & Macfie, H.J.H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies, 11,*103-128.

Donna, L. (2009, December). Fragrance perception is everything relative? *Perfumer and Flavorist*. *34,* 26-35.

Edwards, M. (2008). *Fragrances of the World: Parfums du Monde 2008* (24th ed.). Fragrances of the World, Sidney.

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/153230175.html?page=2.

Fontaine, J.R., Scherer, K.R., Roesch, E.B., & Ellsworth, P.C. (2007). The world of emotions is not two-dimensional. *Psychological Science*, *18,* 1050–1057.

Gibson, E.L. (2006). Emotional influences on food choice: Sensory, physiological and psychological pathways. *Physiology & Behavior*, *89(1),* 53-61. DOI.10.1016/j.physbeh.2006.01.024.

Gleason-Allured, J. (2008, October). Scentworld 2008 report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist.com/events/coverage/31286474.html.

Gleason-Allured, J. (2010a, April). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93719369.html.

Gleason-Allured, J., & Grabenhofer, R. (2010, May 13). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93719369.html.

Gregory, S. (2012, December 5). Enhancing emotional consumer connections. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/manufacturing/packaging/Enhancing-Emotional-Consumer-Connections-182215351.html.

Grubow, L., & Kastner, A. (2011, December). Evolving gender stereotypes drive growth in Asian men's personal care. *GCI Magazine*. Retrieved from http://www.cosmeticsandtoiletries.com/formulating/category/menscare/134765353.html?page=1.

Harper, M., Burns, L.M. (2012, January). Making a fragrance connection through color. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/138487989.html.

Hayden, N. (2009, December). Sun care: To scent or not to scent. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/suncare/78699012.html.

Herman, S. (2012, May). Hot and cold. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/rd/ingredients/149267655.html?page=3.

Higuchi, T., Shoji, K. and Hatayama, T. (2004), Multidimensional scaling of fragrances: A comparison between the verbal and non-verbal methods of classifying fragrances. *Japanese Psychological Research*, *46 (1),* 10–19. DOI: 10.1111/j.1468-5884.2004.00232.x.

Jellinek, P. (1951). *Die Psychologischen Grundlagen der Parfümerie*. Heidelberg: Alfred Hüthig Verlag.

Jellinek, J.S. (1992). Perfume classification: a new approach. In S. Van Toller and G.H. Dodd (Eds.), *Fragrance: The Psychology and Biology of Perfume* (pp. 229–242). London: Chapman and Hall.

Jellinek, P. (1997). The psychological basis of perfumery. In J.S. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp.1-162). London: Chapman and Hall.

John, T.V., Christensen, C., & Boyden, J. (2006). The benefits of fragrance materials: A magazine article. *Perfumer and Flavorist*, *28(6),* 30-43.

King, S.C., & Meiselman, H.L. (2009). Development of a method to measure consumer emotions associated with foods. *Food Quality and Preference, 21*, 168-177.

Lindqvist, A. (2012a). Perfume preferences and how they are related to commercial gender classifications of fragrances. *Chemosensory Perception*, *5(2),* 197-204. DOI: 10.1007/s12078-012-9119-7

Lindqvist, A. (2012b). Preference and gender associations of perfumes applied on human skin. *Journal of Sensory Studies*, *27,* 490–497. DOI:10.1111/joss.12014

Martens, M., & Martens, H., (1986). Partial least squares regression. In J. R. Piggott (Ed.), *Statistical Procedures in Food Research* (pp. 293-359). London and New York: Elsevier Applied Science.

Meilgaard, M., Civile, G.V., & Carr, B.T. (2007). *Sensory Evaluation Techniques (4th ed.)*. Florida, USA: CRC Press.

Milotic, D. (2003). The impact of fragrance on consumer choice. *Journal of Consumer Behaviour, 3,* 179–191. DOI: 10.1002/cb.131.

National Oceanic and Atmospheric Administration. (2012). *National Climatic Data Center (NCDC): The World's Largest Active Archive of Weather and Climate Data Producing and Supplying Data and Publications for the World*. Retrieved from http://www.ncdc.noaa.gov.

Penning, A. (2011, January 19). The sweet smell of your brand's success. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/114217909.html.

Porcherot, C., Delplanque, S., Raviot-Derrien, S., Le Calvé, B., Chrea, C., Gaudreau, N., Cayeux, I. (2010). How do you feel when you smell this? Optimization of a verbal measurement of odor-elicited emotions. *Food Quality and Preference, 21*, 938–947

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. DOI: 10.1016/j.foodqual.2011.07.006.

Rétiveau, A.N., (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRétiveau2004.pdf?sequence=1.

Rétiveau, A.N., Chambers IV, E., & Milliken, G.A. (2004). Common and specific effects of fine fragrances on the mood of women. *Journal of Sensory Studies*, *19,* 373–394. DOI: 10.1111/j.1745-459x.2004.102803.x.

Roberts, S.C., Little, A. C., Lyndon, A., Roberts, J., Havlicek, J., & Wright, R. L. (2009). Manipulation of body odour alters men's self-confidence and judgments of their visual attractiveness by women. *International Journal of Cosmetic Science*, *31,* 47–54. DOI: 10.1111/j.1468-2494.2008.00477.x.

Ruffolo, R. (2011, November). Just follow your nose! *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/132994293.html?mobi=y.

Schiffman, S.S., Sattely-Miller, E.A., Suggs, M.S., & Graham, B.G. (1995). The effect of pleasant odors and hormone status on mood of women at mid-life. *Brain Research Bulletin*. *36,* 19–29.

Schroiff, H.W. (1991). All's well that smells well? *Seminar on Fine Fragrances and Fragrances in Consumer Products Using Research and Development and Optimisation*, London, 13–15 November, E.S.O.M.A.R., Amsterdam.

Stockhorst, U., & Pietrowsky, R. (2004). Olfactory perception, communication and the nose-to-brain pathway. *Physiology and Behaviour, 83,* 3-11.

Tanner, S. (2008, September). Materials: The scent of a winner. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/27917624.html.

Tyrimou, N. (2012, September). skin care market radiant for foreseeable future. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/skincare/167697355.html.

Wormuth, M., Scheringer, M. and Hungerbühler, K. (2005), Linking the use of scented consumer products to consumer exposure to polycyclic musk fragrances. *Journal of Industrial Ecology*, *9,* 237–258. DOI: 10.1162/1088198054084626.

Yeshurun, Y., & Sobel, N. (2010). An odor is not worth a thousand words: from multidimensional odors to unidimensional odor objects. *Annual Review of Psychology*, *61,* 219-241, DOI: 10.1146/annurev.psych.60.110707.163639.

Zarzo, M. (2008). Relevant psychological dimensions in the perceptual space of perfumery odors. *Food Quality and Preference*, *19,* 315–322.

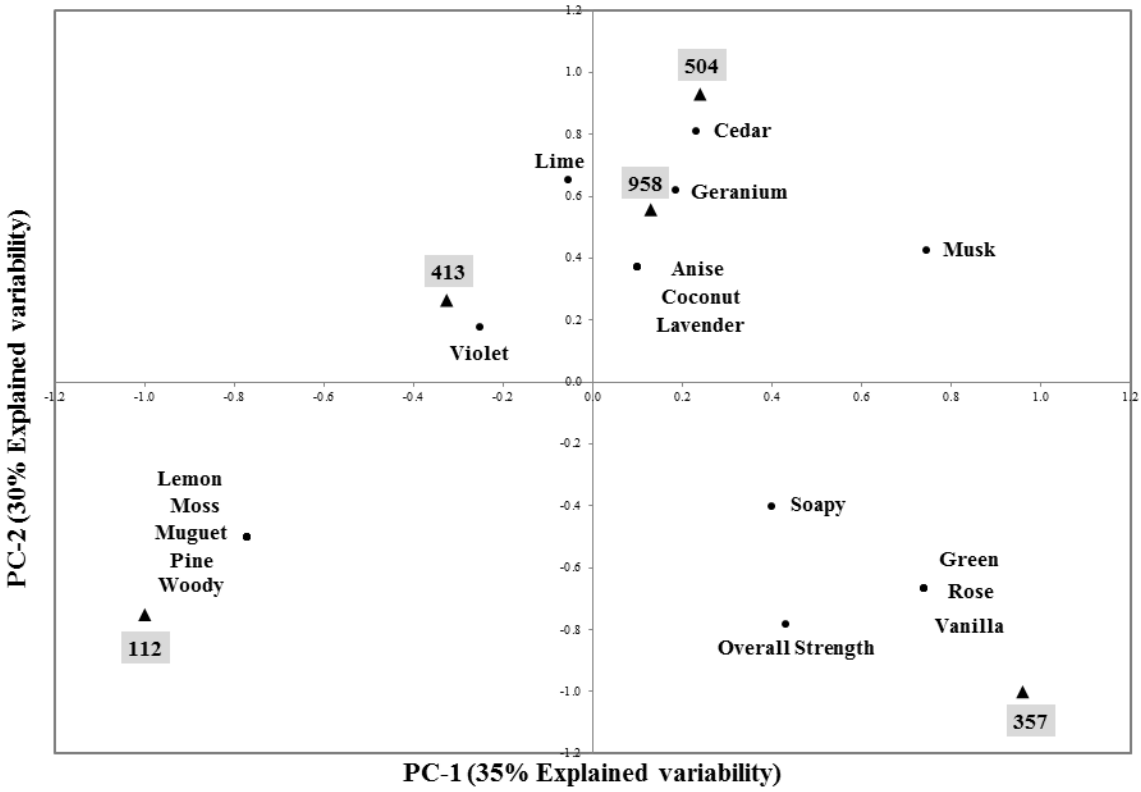
Zarzo, M., & Stanton, D.T. (2009). Understanding the underlying dimensions in perfumers' odor perception space as a basis for developing meaningful odor maps. *Attention, Perception, and Psychophysics*, *71,* 225–247.

Supplementary Results for Chapter 7

Supplementary Table 7.1 Sensory Characteristics of Five Odorant Samples and the Intensity Evaluated by a Fragrance Expert

Characteristics		Odorant sample (Type)				
		112 (Mossy woods/Citrus)	357 (Soft floral/Green)	413 (Floral/Citrus)	504 (Aromatic[Fougère])	958 (Oriental/Floral)
Overall strength		3.5	4.0	3.0	3.0	3.5
Fresh	Green		Green -2.0			
	Citrus	Lemon - 2.0		Lime -2.0	Lime -2.0	
	Aromatics					Lavender -2.0
Floral	Floral	Muguet -2.0		Violet -2.0	Geranium -2.0	
	Soft		Rose -2.0 Soapy -1.0	Soapy -1.0		
	Oriental					Anise -2.0
Oriental			Musk -2.0 Vanilla -3.0		Musk -3.0	Musk -2.0 Coconut -1.0
Woody	Woods	Woods -1.0				
	Dry				Cedar -1.0	Cedar -1.0
	Oriental	Pine -1.0				
	Mossy	Mossy -2.0				

* Intensity of each sensory characteristic was measured on a 5-pt numerical scale (0 = none and 5 = extremely high intensity).



Supplementary Figure 7.1 **Sample and Attribute Plot Derived by Principal Components Analysis on Sensory Profile Data of Five Odorant Samples**

Supplementary Table 7.2 Net Emotion Ratings for 5 Odorant Samples Rated by 240 Participants

Response		Odorant sample/Description					p-value
		413	112	958	504	357	
		Floral/ Citrus	Mossy woods/ Citrus	Oriental/ Floral	Aromatic (Fougère)	Soft floral/ Green	
Odorant liking		**6.92** [a]	**6.73** [a]	6.23 [b]	6.20 [b]	6.10 [b]	**<0.0001**
Emotion	*Pleasant feeling*	**3.82** [a]	0.61 [ab]	-2. 34 [bc]	-4.40 [c]	-3.75 [c]	**0.0005**
	Sensuality	**6.72** [a]	**6.99** [a]	1.59 [b]	2.63 [b]	-0.13 [b]	**0.0008**
	Unpleasant feeling	-4.80 [c]	-2.26 [bc]	1.88 [ab]	**4.81** [a]	3.68 [a]	**<0.0001**
	Relaxation	**1.22** [a]	**0.65** [a]	-8.70 [b]	-6.65 [b]	-7. 23 [b]	**<0.0001**
	Sensory pleasure	7.58 [a]	4.87 [a]	2.86 [a]	2.01 [a]	3.07 [a]	0.0564
	Refreshment	**14.39** [a]	**10.19** [a]	2.75 [b]	1.83 [b]	5.65 [b]	**<0.0001**

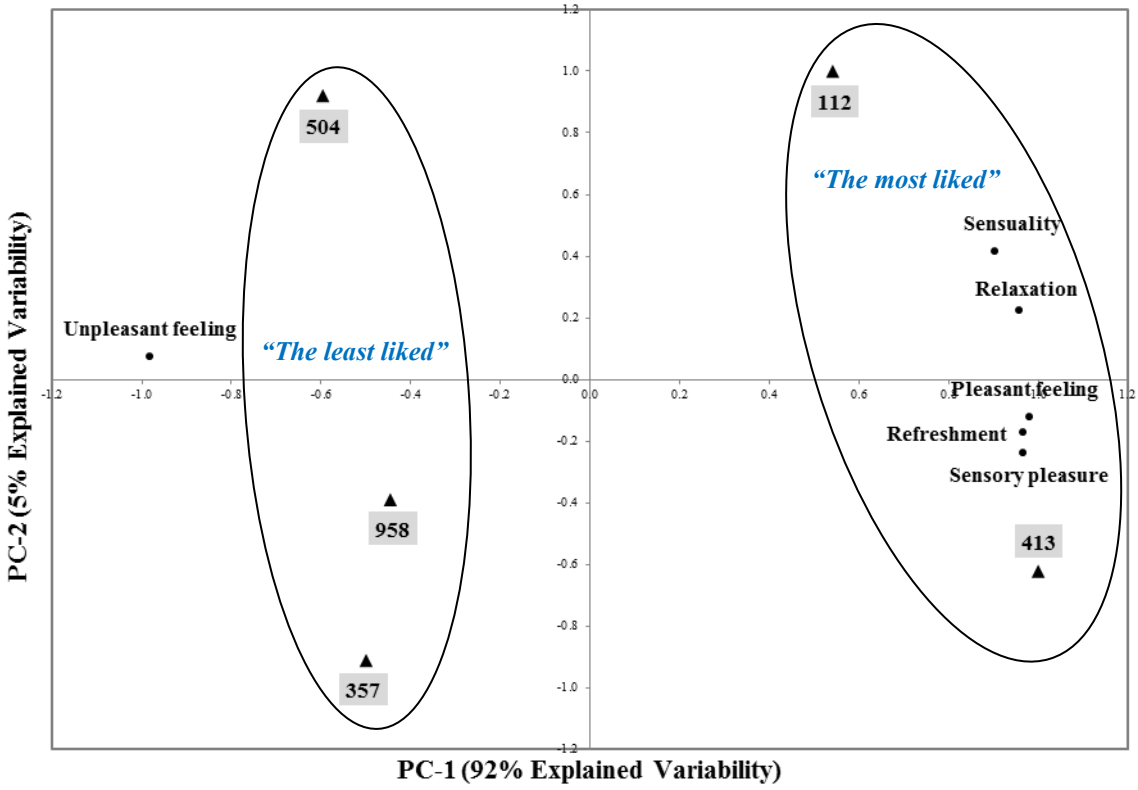
* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Participants evaluated six series of emotion terms, each set consisted of 3 terms: *Pleasant feeling* (*happiness*, *well-being*, and *pleasantly surprised*), *Sensuality* (*romantic*, *desire*, and *in love*), *Unpleasant feeling* (*disgusted*, *irritated*, and *unpleasantly surprised*), *Relaxation* (*relaxed*, *serene*, and *reassured*), *Sensory pleasure* (*nostalgic*, *amusement*, and *mouthwatering*), and *Refreshment* (*energetic*, *invigorated*, and clean). Emotion ratings were the differences between emotion ratings collected before and after odorant evaluation. The emotion ratings were evaluated on a 100 mm line scale where 0 = not intense at all and 100 = very intense.

*** Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test.

**** **Bolded** values represented the highest net emotion ratings ($p<0.05$) of terms toward five odorant samples.

***** Underlined values represented the lowest net emotion ratings ($p<0.05$) of terms toward five odorant samples.



Supplementary Figure 7.2 **Samples and Emotion Ratings Plot Derived by Principal Components Analysis**

Supplementary Table 7.3 Average Association Level of Sensory and Consumer Terms Associated with Five Odorant Samples Obtained from 240 Participants

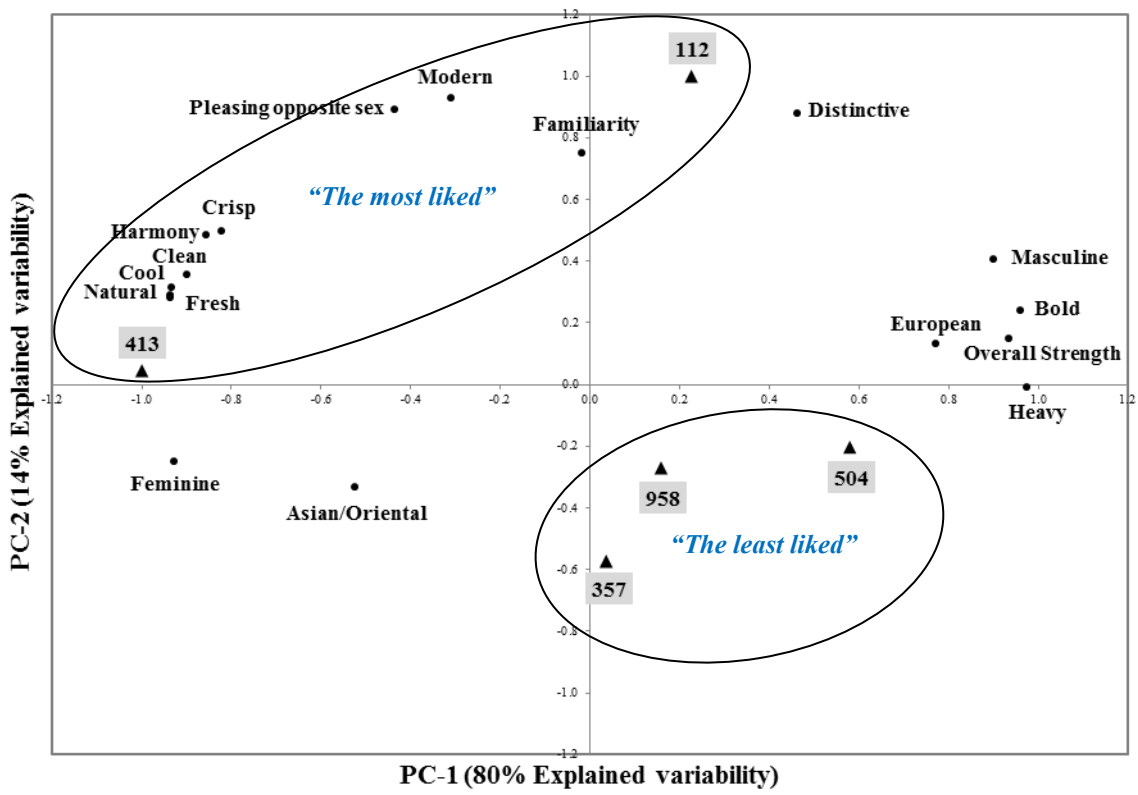
Response		Odorant sample/Description					p-value
		413	112	958	504	357	
		Floral/ Citrus	Mossy woods/ Citrus	Oriental/ Floral	Aromatic (Fougère)	Soft floral/ Green	
Odorant liking		**6.92** [a]	6.73 [a]	6.23 [b]	6.20 [b]	6.10 [b]	**<0.0001**
Sensory and consumer terms	*Overall strength*	2.99 [c]	**3.65** [a]	3.38 [b]	**3.66** [a]	**3.55** [ab]	**<0.0001**
	Bold	2.81 [c]	**3.55** [a]	**3.35** [ab]	**3.50** [ab]	3.31 [b]	**<0.0001**
	Heavy	2.18 [b]	**3.13** [a]	**3.05** [a]	**3.21** [a]	**3.08** [a]	**<0.0001**
	Modern	**3.31** [ab]	**3.44** [a]	3.20 [b]	3.11 [c]	3.06 [c]	**0.0007**
	Clean	**3.86** [a]	3.66 [b]	3. 51 [bc]	3.33 [c]	3.57 [b]	**<0.0001**
	Cool	**3.48** [a]	3.22 [b]	3.05 [bc]	2.96 [c]	3.15 [cb]	**<0.0001**
	Crisp	**3.47** [a]	**3.35** [ab]	3.10 [c]	3.01 [c]	3.21 [bc]	**<0.0001**
	Fresh	**3.82** [a]	3.50 [b]	3.40 [b]	3.13 [c]	3.40 [b]	**<0.0001**
	Harmony	**3.23** [a]	3.03 [b]	2. 85 [bc]	2.83 [c]	2.85 [bc]	**<0.0001**
	Familiarity	**3.15** [ab]	**3.29** [a]	2.93 [c]	**3.15** [ab]	3.09 [bc]	**0.0096**
	Natural	**3.23** [a]	2.97 [b]	2.93 [b]	2.70 [c]	2.88 [bc]	**<0.0001**
	Pleasing opposite sex	**3.50** [ab]	**3.56** [a]	3.28 [bc]	3.26 [c]	3.18 [c]	**0.0029**
	Distinctive	3.35 [a]	3.54 [a]	3.40 [a]	3.42 [a]	3.33 [a]	0.1883
	European	2.73 [a]	2.90 [a]	2.77 [a]	2.90 [a]	2.90 [a]	0.2114
	Asian/Oriental	2.01 [a]	1.94 [a]	2.05 [a]	1.86 [a]	2.02 [a]	0.1093
	Masculine	3.12 [d]	**3.84** [a]	3.61 [b]	**3.83** [a]	3.38 [c]	**<0.0001**
	Feminine	**2.55** [a]	1.84 [cd]	1.91 [c]	1.70 [d]	2.26 [b]	**<0.0001**

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** Association level of sensory and consumer terms on odorants sample were evaluated using a 5-point scale where 1 = not at all, and 5 = extreme. Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test.

*** **Bolded** values represented the highest association level ($p<0.05$) of terms toward five odorant samples.

**** Underlined values represented the lowest association level ($p<0.05$) of terms toward five odorant samples.



Supplementary Figure 7.3 **Samples and Degree of Sensory and Consumer Terms Associated with Five Odorant Samples Derived by Principal Components Analysis**

Supplementary Table 7.4 Agreement Rating on Potential Application for Personal Care Products of 5 Odorant Samples Obtained from 240 Participants

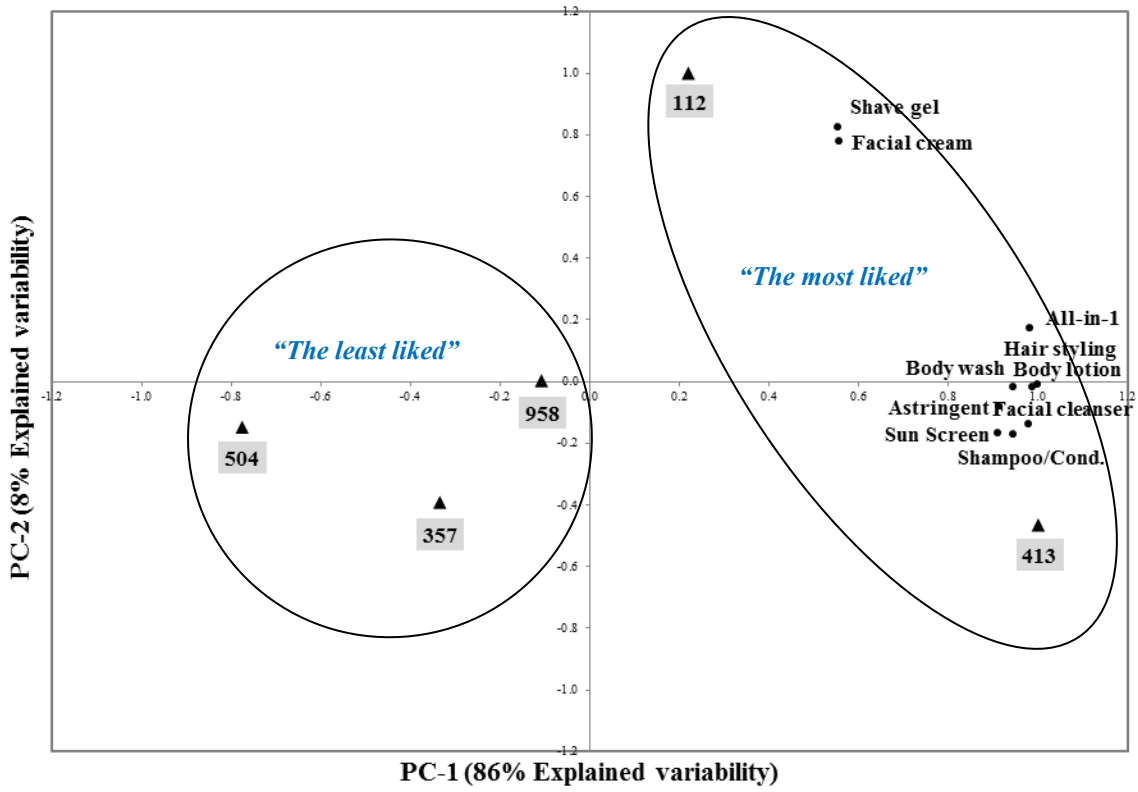
Response			Odorant sample/Description					p-value
			413	112	958	504	357	
			Floral/ Citrus	Mossy woods/ Citrus	Oriental/ Floral	Aromatic (Fougère)	Soft floral/ Green	
Odorant liking			**6.92** [a]	6.73 [a]	6.23 [b]	6.20 [b]	6.10 [b]	**<0.0001**
Application	Body care	All-in-one	**3.67** [a]	**3.53** [ab]	3.40 [bc]	3.20 [c]	3.29 [c]	**<0.0001**
		Body wash	**3.91** [a]	**3.73** [ab]	3.63 [b]	3.38 [c]	3.67 [b]	**<0.0001**
		Body lotion	**3.55** [a]	3.24 [b]	3.21 [bc]	2.86 [d]	3.04 [cd]	**<0.0001**
	Facial care	Facial cleanser	**3.24** [a]	2.95 [b]	2.85 [bc]	2.73 [c]	2.82 [bc]	**<0.0001**
		Facial cream	**3.39** [ab]	**3.56** [a]	3.28 [b]	3.26 [b]	3.28 [b]	**0.0150**
		Astringent	**3.08** [a]	2.85 [b]	2.88 [b]	2.73 [b]	2.70 [b]	**0.0004**
		Shave gel	3.39 [b]	**3.59** [a]	3.37 [b]	3.24 [b]	3.21 [b]	**0.0010**
		Sunscreen	**2.48** [a]	2.14 [b]	2.12 [bc]	2.04 [bc]	1.97 [c]	**<0.0001**
	Hair care	Shampoo and conditioner	**3.35** [a]	3.03 [b]	2.89 [bc]	2.71 [c]	3.01 [b]	**<0.0001**
		Hair styling	**3.20** [a]	2.98 [b]	2.88 [b]	2.68 [c]	2.84 [bc]	**<0.0001**

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** The agreement on potential application for personal care products was evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree. Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test.

*** **Bolded** values represented the highest association level ($p<0.05$) of terms toward five odorant samples.

**** Underlined values represented the lowest association level ($p<0.05$) of terms toward five odorant samples.



Supplementary Figure 7.4 **Samples and Agreement Rating of Five Odorant Samples on Potential Application in Personal Care Products Derived by Principal Components Analysis**

Supplementary Table 7.5 Agreement Rating on Use Occasions of 5 Odorant Samples Obtained from 240 Participants

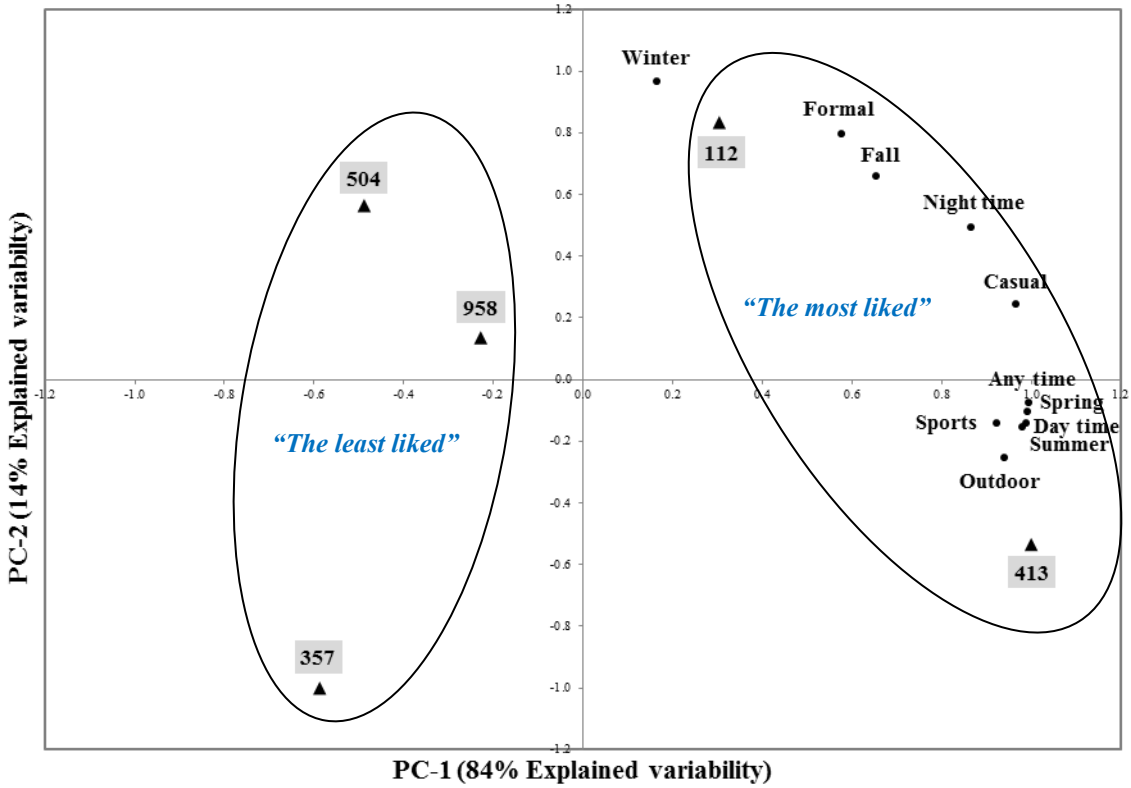
Response			Odorant sample/Description					p-value
			413	112	958	504	357	
			Floral/ Citrus	Mossy woods/ Citrus	Oriental/ Floral	Aromatic (Fougère)	Soft floral/ Green	
Odorant liking			**6.92** [a]	**6.73** [a]	6.23 [b]	6.20 [b]	6.10 [b]	**<0.0001**
Occasional usage	Time	Day	**3.53** [a]	3.25 [b]	3.12 [bc]	2.99 [c]	3.03 [c]	**<0.0001**
		Night	3.39 [a]	3.40 [a]	3.26 [a]	3.24 [a]	3.11 [a]	0.0606
		Anytime	**3.45** [a]	3.21 [b]	3.08 [b]	3.00 [b]	2.99 [b]	**0.0002**
	Season	Spring	**3.88** [a]	3.56 [b]	3.36 [bc]	3.27 [c]	3.28 [c]	**<0.0001**
		Summer	**3.88** [a]	3.48 [b]	3.32 [bc]	3. 25 [c]	3.24 [c]	**<0.0001**
		Fall	3.53 [a]	3.51 [a]	3.47 [a]	3.50 [a]	3.28 [a]	0.0876
		Winter	**3.31** [ab]	**3.51** [a]	**3.43** [a]	**3.43** [a]	3.18 [b]	**0.0206**
	Activity	Sports	**2.92** [a]	**2.83** [ab]	2.71 [bc]	2.55 [c]	2.67 [bc]	**0.0034**
		Outdoor	**2.95** [a]	**2.81** [ab]	2.74 [bc]	2.61 [c]	2.71 [bc]	**0.0166**
		Formal	**3.25** [ab]	**3.42** [a]	3.14 [bc]	**3.24** [ab]	2.96 [c]	**0.0015**
		Casual	**3.60** [a]	3.48 [ab]	3.32 [bc]	3.30 [bc]	3.15 [c]	**0.0004**

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** The agreement on use occasions of each odorant sample were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree. Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test.

*** **Bolded** values represented the highest association level ($p<0.05$) of terms toward five odorant samples.

**** Underlined values represented the lowest association level ($p<0.05$) of terms toward five odorant samples.



Supplementary Figure 7.5 **Samples and Agreement Rating of Five Odorant Samples on Use Occasions Derived by Principal Components Analysis**

Supplementary Table 7.6 Agreement Rating on Expectation of Functional Benefits of 5 Odorant Samples Obtained from 240 Participants

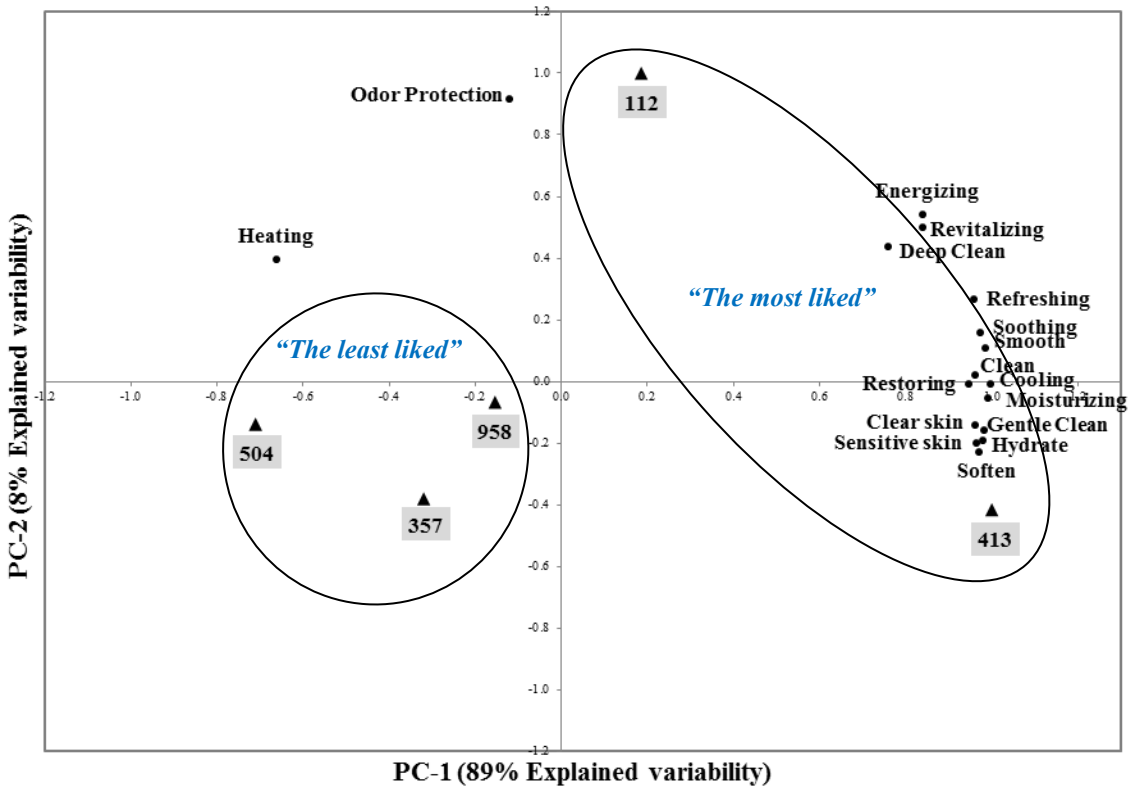
Response		Odorant sample/Description					p-value
		413	112	958	504	357	
		Floral/ Citrus	Mossy woods/ Citrus	Oriental/ Floral	Aromatic (Fougère)	Soft floral/ Green	
Odorant liking		**6.92** [a]	**6.73** [a]	6.23 [b]	6.20 [b]	6.10 [b]	**<0.0001**
Functional benefits	*Hydrate*	**3.45** [a]	3.07 [b]	3.05 [b]	2.83 [c]	3.01 [b]	**<0.0001**
	Moisturizing	**3.44** [a]	3.14 [b]	3.01 [bc]	2.84 [c]	3.03 [b]	**<0.0001**
	Energizing	**3.70** [ab]	**3.75** [a]	3.51 [bc]	3.34 [c]	3.41 [c]	**<0.0001**
	Refreshing	**3.85** [a]	**3.75** [ab]	3. 62 [bc]	3.44 [c]	3.51 [c]	**0.0001**
	Gentle clean	**3.74** [a]	3.39 [b]	3.30 [bc]	3.16 [c]	3.32 [bc]	**<0.0001**
	Deep clean	3.27 [a]	3.30 [a]	3.14 [a]	3.10 [a]	3.21 [a]	0.1803
	Clean	**3.86** [a]	3.66 [b]	3.51 [bc]	3.33 [c]	3.57 [b]	**<0.0001**
	Sensitive skin	**3.16** [a]	2.80 [b]	2.75 [b]	2.66 [b]	2.71 [b]	**<0.0001**
	Clear skin	**3.25** [a]	2.93 [b]	2.82 [b]	2.78 [b]	2.82 [b]	**<0.0001**
	Smooth	**3.65** [a]	**3.47** [ab]	3.35 [bc]	3.23 [c]	3.27 [c]	**<0.0001**
	Softening	**3.40** [a]	3.04 [b]	3.04 [b]	2.85 [c]	3.00 [bc]	**<0.0001**
	Soothing	**3.56** [a]	3.37 [b]	3.25 [bc]	3.07 [c]	3.10 [c]	**<0.0001**
	Restoring	**3.32** [a]	3.13 [b]	3.13 [b]	2.99 [b]	2.98 [b]	**0.0023**
	Revitalizing	**3.58** [a]	**3.60** [a]	**3.45** [ab]	3.25 [c]	3.28 [bc]	**0.0003**
	Cooling	**3.54** [a]	3.27 [b]	3.17 [b]	2.95 [c]	3.12 [bc]	**<0.0001**
	Heating	2.39 [a]	2.50 [a]	2.50 [a]	2.58 [a]	2.40 [a]	0.1825
	Odor protection	3.30 [b]	**3.61** [a]	3.30 [b]	3.41 [b]	3.36 [b]	**0.0054**

* Odorant liking was evaluated on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

** The agreement on expectation of functional benefits of each odorant sample were evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree. Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test. .

*** **Bolded** values represented the highest association level ($p<0.05$) of terms toward five odorant samples.

**** Underlined values represented the lowest association level ($p<0.05$) of terms toward five odorant samples.



Supplementary Figure 7.6 **Samples and Agreement Rating of Five Odorant Samples on Expectation of Functional Benefits Derived by Principal Components Analysis**

Chapter 8 - Consumer Classification Based on Olfactory Acceptance Patterns

Abstract

Consumer segmentation based on product acceptance patterns is important because it provides information to product developers and marketers about their consumer targets and can help in developing specific product for each consumer group. This study focused on olfactory acceptance, which is a primary driver for consumer acceptance in fragrance and personal care product categories. The objectives of this study aimed to classify consumers based on olfactory acceptance patterns and compare responses obtained from different consumer segments.

Two hundred and forty consumers were classified into five consumer segments based on similarity of olfactory acceptance patterns toward five masculine odorants. Similar relationships between the preferred odorants and olfactory responses were found across all consumer segments. The preferred odorants positively generated and enhanced consumer responses, leading to positive emotion experience elicitation and negative emotion reduction. The preferred odorants enhanced potential of application in most use occasions, application in personal care products, and expectation of the functional benefits. In contrast, the less liked odorants negatively influence consumer responses, leading to lower ratings in many categories of response than those for preferred odorants. In addition, more liked odorants generally were associated with terms such as *fresh, crisp, natural,* and *modern*. On the other hand, terms such as *heavy* and *bold* were generally associated with the less liked odorant samples by the consumers in all segments.

Introduction

Researchers in sensory science, psychology, and marketing research use personal factors (e.g., demographic information and psychographic disposition) for classifying consumers into specific populations for consumer research (Haugtvedt, Kardes, & Herr, 2008; Kergoat et al., 2010). Previous studies indicated that consumer classification using personal factors yield a good understanding of consumer preference and product consumption; however, there is no sufficient explanation about why consumers prefer one product over another (Kergoat et al., 2010).

At present, consumers are aware of personal appearance leading to an emerging fragrance and personal care market growth, globally reached approximately $96.5 billion in 2011 (Tyrimou, 2012). Because consumer's initial purchase decision for fragrance and personal care products is primarily impacted by fragrance appreciation (Schroiff, 1991; Milotic, 2003; Gleason-Allured, 2008; Tanner, 2008; Gleason-Allured, 2010; Gleason-Allured & Grabenhofer, 2010; Grubow & Kastner, 2011). Consumers screen personal products by looking at a brand or a package that is visually attractive, and then smelling that particular product to decide whether they would like to purchase or not (Tanner, 2008; Penning, 2011; Harper & Burns, 2012).

Acceptability and preference are commonly used as the core evaluative constructs for predicting food choice and behavior (MacFie & Thomson, 1994). The acceptance pattern of each consumer toward alternative products is found to be heterogeneous (Honkanen, Olsen, & Myrland, 2006). Therefore, an application of acceptance factors for understanding consumer segmentation is thought to be important and appropriate for managerial implementation (Kardes, 1999; Honkanen et al., 2006). Often times, segmentation is applied to preference values or liking scores resulting in distinct clusters of liking patterns (Kergoat et al., 2010). Because odorant appreciation is driven by desire and need for emotional connection, sensorial experience, and

pleasure (Gleason-Allured, 2008), the preferred odorants would create and enhance a great consumption experience to consumers leading directly to repeat usage and brand loyalty (Gleason-Allured, 2010; Penning, 2011; Falk & Penning, 2012). On the other hand, the unpleasant odorants would provide different experiences and perceptions, vice versa. Therefore, understanding consumers from different acceptance patterns would aid researchers in developing a successful product specifically for each consumer group.

A product developer should have a good understanding of how scents interact with human perceptions (i.e. physiological and psychological effects) and functional properties of scents (Jellinek, 1951; Jellinek, 1997; Zarzo & Stanton, 2009). A product's smell should have olfactory cues or signal to reinforce, compliment, or initiate expectation to the promise or benefit of a product to consumers (Deliza & MacFie, 1996; Gleason-Allured, 2008; Ruffolo, 2011; Falk & Penning, 2012; Gregory, 2012). Thus, repeat consumption would occur when consumer expectation and satisfaction reach parity (Deliza & MacFie, 1996).

Therefore, researchers focused on olfactory acceptance in in this study. The objectives of this study aimed to (1) classify consumers based on similarity of odorant liking patterns and (2) compare selected responses to olfactory related cues across consumer segments.

Materials and Methods

Odorants Selection and Preparation

Odorant Selection

Four masculine odorants purposely made for personal care products and a commercially available cologne representing a wide spectrum of masculine fragrances and having different odor characteristic from each other, were used in the study.

Sample Preparation

A 0.5 mL sample of each odorant was transferred on a cotton swab (Qtips®, Uniliver, USA) using disposable 1 mL tuberculin syringe (sterilized) (Fisher Scientific Inc., PA). The cotton swabs were pre-cut in half, length wise (4 cm). The scented cotton swab was then placed with the swab side down in an amber vial (3.7 mL) (Fisher Scientific Inc., PA) with 3-digit code. Each vial was tightly closed immediately after the scented swab inserted.

All samples were packed individually in a clear bubble bag (Staple®, USA) to protect from damage. A label having a letter "A" was placed onto a bag to represent the first sample for evaluation. The other labels (B, C, D, and E), which represented evaluation order from 2^{nd} to 5^{th} were on samples by the assigned presentation order. The five samples were packed in a postage box and sent out to a fragrance expert and consumers using the United States Postal Office (USPS). The sample set was assumed to arrive at the destination within 1-3 business days.

The test was conducted when the average temperature across the country was at the range of 42-56 °F (National Oceanic and Atmospheric Administration [NCDC], 2012). This information provided assurance that the fragrance samples had not deteriorated during transport.

Descriptive Evaluation of Odorant Samples by a Fragrance Expert

Sample Evaluation

Each sample was evaluated by a fragrance expert who had 10 years of experience in fragrance evaluation. The expert evaluated and generated descriptive terms to characterize each odorant sample. Necessary references were determined to anchor and calibrate the intensity measurement on a 5-pt numerical scale (0 = none and 5 = extremely high intensity). The evaluation sessions were conducted in 1-2 hour sessions in the morning.

Consumer Test

Respondents

A total of 976 consumers across United States completed the Big-Five personality survey (Big-Five Inventory, BFI) and claimed to men who use colognes or fragranced personal care products, or women who like the smell of colognes or personal care products on men.

Three hundred consumers were first classified based on gender, age, and personality. Fifty consumers from each sub-demographic (2 genders x 3 age groups [18-25, 26-35, and 36-49]) were randomly selected to participate in this study. The selected participants also possessed one of 5 different personality patterns (55-73 respondents per personality group) (Chapter 4).

Internet Survey

Participants were asked to evaluate each sample anytime within the 3 days at their home. They also were asked to evaluate another odorant sample in the next following days. The online-survey for each sample was available only on the specified dates. The participants could not revisit the survey, and they were not allowed to do a make-up test if missed. The test was available for 2 weeks for the participants to complete. On the evaluation day, respondents were

asked to log in to the website and enter the sample code appearing on the label of the sample vial to access the survey.

Questionnaires

- Emotion Questions and Modification

Consumers were asked to evaluate emotions/feelings before and right after smelling an odorant sample using ScentMove™ (Porcherot et al., 2010). Consumers rated the pertinence of each of the six series of three feeling terms on a 10-cm linear scale ranging from "no feelings" (0) to "very intense feelings" (100).

- Odorant Acceptance

Each consumer was asked to indicate how much they liked or disliked the smell of each odorant sample on a 9-point hedonic scale where 1 represented dislike extremely, 5 represented neither dislike nor like, and 9 represented like extremely.

- Degree of Sensory and Consumer-Related Terms Associated with an Odorant

A questionnaire consisting of an odor strength rating and sixteen sensory and consumer-related terms, modified from previous studies and articles (Jellinek, 1992; Higuchi, Shoji, & Hatayama, 2004; Gleason-Allured, 2008; Zarzo & Stanton, 2009; Falk & Penning, 2012; Lindqvist, 2012a; Porcherot et al., 2012), was used for evaluation. Consumers were asked to indicate the association level of terms toward an odorant using a numerical scale, ranging from 1 = not at all to 5 = extreme.

- Agreement/Disagreement on Occasional Usage Statements

Consumers were asked to identify the level of their agreement or disagreement toward 11 different situations on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The set of given situations consisted of time of the day, seasons, activities, and occasions and was

developed and modified from Aarts' (2003) and Rétiveau's (2004) studies. A question "If you are going to wear this cologne, when would you wear it?" was used to introduce each statement to consumers.

- Agreement/Disagreement on Potential Application in Personal Care Products

Ten personal care categories modified from Wormuth, Scheringer, & Hungerbühler, (2005), were presented to consumers. Consumers were asked to indicate how much they agree or disagree on an appropriateness of the scent to be found in a particular personal care category using 5-point Likert scale (1 = disagree strongly to 5 = agree strongly).

- Agreement/Disagreement on Expectation of Functional Benefits

Consumers indicated relevancy of relationships between an odorant and seventeen functional benefits using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Consumers were asked to think about scent they smelled, if it provided any particular functional benefits.

Data analysis

Data Preparation: Consumer Classification Based on Similarity of Liking Pattern

The hedonic score of all 5 odorants rated by each consumer were subjected to Ward's hierarchical clustering method using PROC CLUSTER of SAS® (version 9.2; SAS Institute, Cary, NC, USA).

Internal Preference Mapping and Consumer Segmentation

The Unscrambler® 10.2 (version 10.2, CAMO Software Inc., Woodbridge, NJ, USA) was used to conduct internal preference mapping using Principal Component Analysis (PCA) to locate odorant samples on the map using hedonic scores of all consumers. In addition, the mean

hedonic score of each odorant sample from each consumer cluster was subjected to PCA for ease of interpretation (Schilch, 1995; Yenket, 2011).

The hedonic scores of all consumers were subjected to cluster analysis, using Ward's hierarchical clustering method of SAS® (version 9.2; SAS Institute, Cary, NC, USA).

Analysis of Significant Differences for the variables obtained from consumers

For each consumer cluster, liking data were analyzed for Analysis of Variance using a GLIMMIX model at 5% level of significance (SAS®). The odorant, consumer segment, and interaction of odorant by consumer segment were treated as fixed effects. Respondent within a cluster was treated as a random effect. Mean separation tests (multiple t-tests) were carried out to compare the means if significant difference exists.

Results and Discussion

Sensory Profile of Odorant Samples

The fragrance expert characterized odorant 112 as *chypré* based on the presence of *mossy, woody,* and *citrus,* whereas odorant 357 was described as *soft floral/green* related to the presence of *soapy, vanilla, rose,* and *musk*. Odorant 413 was characterized as *floral-citrus* based on presence of *lime* and *violet* and odorant 504 was characterized as *aromatic fougère*, consisting of *geranium, cedar, lime,* and *musk* smells. Lastly, odorant 958, an *oriental-floral* odorant, was characterized by *geranium, cedar, lime,* and *musk* (Table 8.1). The characteristics of five odorant samples and the intensity of each attribute were shown in Supplementary Table 8.1. The sensory profile of odorant samples was illustrated on a PCA bi-plot map indicating diverse odor characteristics as samples located apart from each other (Supplementary figure 8.1).

Table 8.1 Odorant Samples with Classification and Description

Odorant type	Odorant	Edwards' classification	Description
Odorant purposely made for personal care product	112	Mossy woods - Citrus	Chypré: moss, citrus, floral, woody
	357	Soft floral - Green	Soapy, vanilla, musk, rose
	413	Floral-Citrus	Lime, violet
	958	Oriental-Floral	Lavender, coconut, anise, musk
Commercial cologne	504	Aromatic	Fougère: geranium, cedar, lime, musk

Consumer Segmentation Using Liking Patterns

Internal preference mapping generated from liking scores of each consumer. The bi-plot of the first two PCs explained 60% of the total variation of the data (PC 1 and 2 accounted for 34 and 26%, respectively) (Figure 8.1). The map demonstrated that consumers liked the odorant samples differently as consumers (dots) and samples distributed across the 4 quadrants.

The map also showed that consumers were distributed across the map suggesting that clusters were possible. Odorant 112, 357, and 413 had consumers located around/nearby which suggests that certain consumers liked or preferred these odorants over the other samples. On the other hand, the other two odorants (504 and 958) separated apart from each other. Both samples had a few consumers located around/nearby indicating that only a few consumers preferred these samples over other samples. Based on the olfactory liking scores given toward odorants, the consumers were, then, segmented into subgroups based on similarity of olfactory liking or liking pattern.

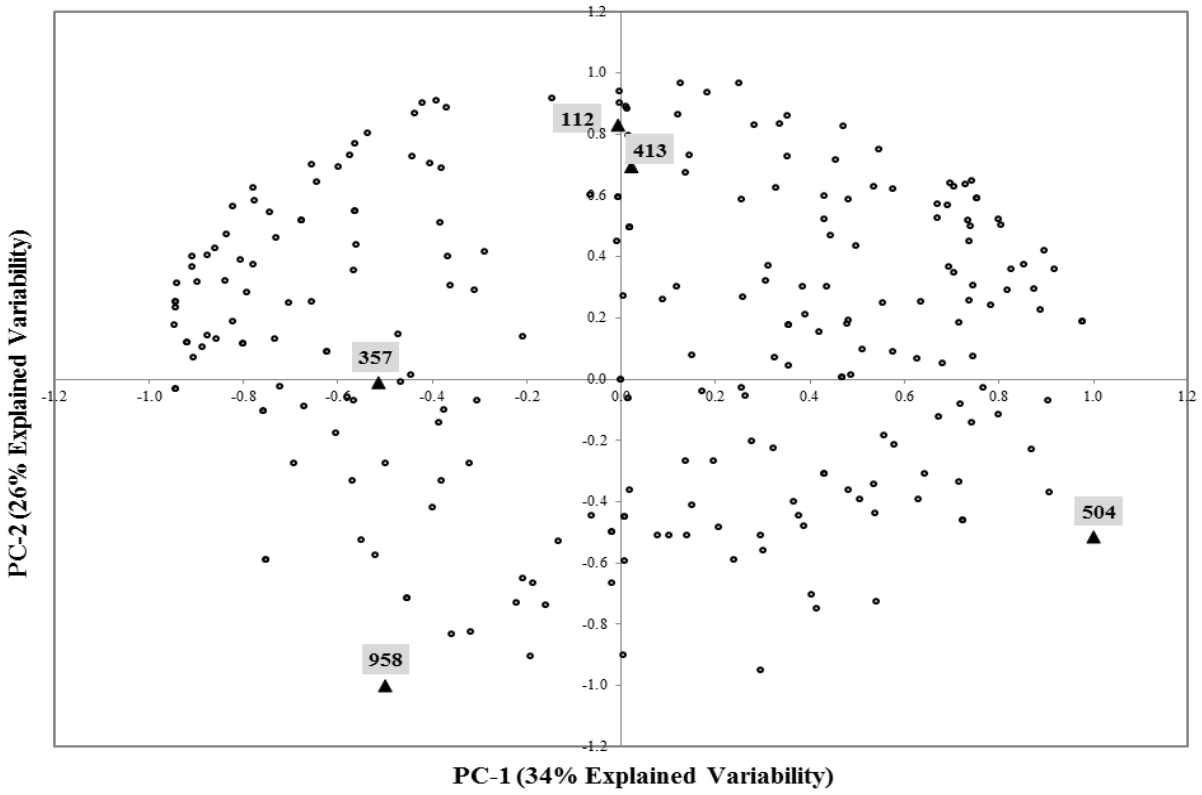


Figure 8.1 **Internal Preference Map Obtained by PCA on Individual Consumer Scores for Olfactory Liking**

Five consumer segments were generated based on similarity and dissimilarity of olfactory liking patterns. Consumers of different genders, age, and personality patterns were found across all consumer segments (Supplementary Table 8.2). This evidence indicated that gender, age, and personality did not influence a person's liking pattern which is similar to results found by Lidqvist (2012b) who reported that gender did not affect odor preference. However, the results conflicted with a study of Konstantinidis, Hummel, and Larsson (2006) who reported that age could affect preference.

The overall analysis of significant difference demonstrated that consumers from different groups had different acceptance levels toward the odorant samples ($p<0.0001$) (Table 8.2).

Table 8.2 Olfactory liking Scores of Five Consumer Segments on Five Odorant Samples

Consumer segment	N	Odorant/Description					p-value	Average liking score (across 5 samples)
		112	357	413	504	958		
		Mossy woods/ Citrus	Soft floral/ Green	Floral/ Citrus	Aromatic (Fougère)	Oriental /Floral		
A	50	7.00 [a]	6.58 [ab]	7.06 [a]	3.10 [c]	6.22 [b]	<0.0001	5.99 [b]
B	96	7.25 [b]	6.77 [c]	7.74 [a]	7.41 [ab]	7.49 [ab]	<0.0001	7.33 [a]
C	27	7.11 [a]	4.89 [b]	4.63 [b]	6.74 [a]	6.89 [a]	<0.0001	6.05 [b]
D	49	6.82 [a]	5.65 [b]	6.71 [a]	6.94 [a]	3.47 [c]	<0.0001	5.92 [b]
E	18	2.39 [c]	4.22 [b]	6.17 [a]	5.50 [ab]	6.06 [a]	<0.0001	4.87 [c]
p-value (sample)								<0.0001
p-value (consumer segment)								<0.0001
p-value (sample*consumer segment)								<0.0001

*Olfactory liking scores were evaluated using a 9-point Acceptance scale where 1 = dislike extremely, and 9 = like extremely. Least square means with the same letter within a row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test.

- Consumer segment A (CL-A), *"Consumer who disliked sample 504"* consisted of 50 consumers who liked all samples (scores above 6.0 points), mainly characterized by *floral, citrus, woody,* and *oriental* smells, except for sample 504 (contained geranium) which was rated slightly above 3.0 on a 9-point hedonic scale. They did differentiate in liking among the most liked samples

- Consumer segment B (CL-B), *"Consumers who liked all samples"* consisted of 96 consumers who seemed to like any samples (scores above 6.0 points). Their ratings for each odorant were similar to the ratings obtained from a whole consumer panel. Consumers in this segment had the lowest liking for sample 357 (contained *green, rose,* and *vanilla notes)* when compared to the other samples.

- Consumer segment C (CL-C), *"Consumers who disliked sample 357 and 413"* consisted of 27 consumers who liked 112, 958, and 504. These odorants characterized by woody (*pine, mossy, woody*), aromatics fougère (*lavender* and *geranium*), and some of floral notes

(except for the *violet, rose,* and *vanilla*) more than odorants 357 and 413 (contained soapy characteristic).

- Consumer segment D (CL-D), *"Consumers who disliked sample 958 and were neutral to sample 357"* consisted of 49 consumers. Sample 112, 413, and 504 were parity in odorant acceptability (contained floral and citrus notes), with mean values of 6.7-6.9 on a 9-point scale, followed by sample 357 which received a lower liking score. Odorant 958 was disliked (contained musk note).

- Consumer segment E (CL-E), "*Consumers who disliked sample 112 and 357*", had the smallest number of consumers within this group. It consisted of 18 consumers who slightly liked odorant sample 413, 504, and 958 (characterized by floral and citrus) but who disliked 357 and strongly disliked 112 (contained muguet and woody notes).

Relationship between Five Classified Consumer Segment and Olfactory Responses

Strong relationships between consumer olfactory liking toward emotions and other olfactory responses were commonly found in all consumer segments. Because consumers from different segments liked and preferred different smells, each consumer segment had different responses toward a specific odorant depending on how they liked its smell (Penning, 2011). Results demonstrated the same relationship between the most liked odorant samples and olfactory responses regardless of consumer segment and regardless of which odorant was liked most. The most liked odors within in segment induced consumer's positive thoughts, feelings, and affective response reactions within that segment of consumers. This suggests that liking is a strong positive motivator for fragrances and that individuals who like a particular fragrance might have further benefits regarding cognitive, social, psychological, physiological, and

physical performance enhancements to those fragrances, which is similar to the suggestion by Raudenbush (2005). Pleasantness is the principal foundation of perception in emotional dimensions (Fontaine et al., 2007; Yeshurun & Sobel, 2010). Thus pleasant odorants induced positive emotions (Table 8.3), whereas unpleasant odors induced negative emotions of consumers and depressed mood (Rétiveau, Chambers, & Miliken, 2004; Schiffman et al., 1995) (Table 8.4).

Consumers from all segments commonly associated most sensory and consumer terms (e.g., *clean*, *crisp*, *modern*, *fresh*, *familiar*, *natural*, etc.) with the most liked samples. Herz (2003) and Gibson (2006) indicated that consumers highly and positively associated "*natural"* and "*familiar"* with odors they like. Consumers from all segments commonly associated *heavy* and *bold* with odors they liked the least (Table 8.4). In this study, consumers from segment C and E associated terms such as *feminine* and *Asian/oriental* with the least liked sample (Table 8.4).

This study also noted the positive influence of pleasant odors (most liked odors) on potential use occasion. Consumers from segment A, C, D, and E indicated that the most liked samples were suitable for most occasions, except for sports and outdoor activities. Similar agreement responses were found in consumer from segment B. However, these consumers indicated that the most liked odorants were suitable in all situations (Table 8.3). That is not surprising because segment B also liked all fragrances and potentially were the people who would appreciate and enjoy the odorants in any situation. In contrast, consumers perceived the least liked odors being unsuitable for any of use occasions (Table 8.4).

Table 8.3 Relationship between the Most Liked Odorant Samples and Other Olfactory Responses obtained from Five Classified Consumer Segments

	Segment A	Segment B	Segment C	Segment D	Segment E
Samples	413, 112, 357,958	413, 112, 504,958	112, 958, 504	504, 112, 413	413, 958, 504
Positive emotions	Increase	Increase	Increase	Increase	Increase
Unpleasant feeling	Decrease	Decrease	Decrease	Decrease	Decrease
Associated sensory and consumer terms	All terms, except for *heavy* and *bold*	All terms, except for *heavy* and *bold*	All terms, except for, *feminine* and *Asian/oriental*	All terms, except for *heavy*, *bold,* and *Asian/oriental*	All terms, except for *heavy*, *bold, European, feminine,* and *Asian/oriental*
Potential occasions	All occasions, except for sports and outdoor activities	All occasions	All occasions, except for sports and outdoor activities	All occasions, except for sports and outdoor activities	All occasions, except for sports and outdoor activities
Potential application in personal care products	All, except for astringent and sunscreen	All, except for astringent and sunscreen	All, except for astringent and sunscreen	All, except for astringent and sunscreen	All, except for astringent and sunscreen
Expectation of functional benefits	All (except for heating property)	All (except for heating property)	All (except for heating property)	All (except for heating property)	All (except for heating property)

* Positive emotions included *pleasant feeling, relaxation, sensuality, sensory pleasure,* and *refreshment*

The positive impact of pleasant odor also was found in responses to potential application in personal care products and expectation of functional benefits. Consumers from all segments indicated that the most like samples were suitable for most product categories, except for astringent and sunscreen category perhaps because the products generally having a fragrance-free or a simple scent (Hayden, 2009). In addition, consumers also had high expectations of most functional benefits, except for the heating property (Table 8.3). In contrast, consumers in all segments perceived the least like samples being incompatible with any of personal care category, nor did the least liked samples raise expectations of functional benefit (Table 8.4).

Table 8.4 Relationship between the Most Liked Odorant Samples and Other Olfactory Responses obtained from Five Classified Consumer Segments

	Segment A	Segment B	Segment C	Segment D	Segment E
Sample	504	357	357, 413	357,958	112 ,357
Positive emotions	Decrease	Decrease	Decrease	Decrease	Decrease
Unpleasant feeling	Increase	Increase	Increase	Increase	Increase
Terms	*heavy* and *bold*	*heavy* and *bold*	*feminine* and *Asian/oriental*	*bold, heavy,* and *Asian/oriental*	*heavy*, *bold, European, feminine,* and *Asian/oriental*
Use occasion	none	none	none	none	none
Potential application	none	none	none	none	none
Functional benefits	none	none	none	none	none

* Positive emotions included *pleasant feeling, relaxation, sensuality, sensory pleasure,* and *refreshment*

Conclusion

Consumers were classified based on similarity of olfactory liking patterns into 5 segments. Each consumer segment had different appreciation levels toward each odorant sample. However, the same relationship between the most liked odorants by each individual segment and other olfactory responses were found across all consumers groups. Consumers experienced positive emotions when they smelled the liked odorants. In contrast, consumers experienced more negative or less positive emotions when they smelled odorants they did not like or liked less than others. Results also demonstrated that odorant samples even though they received similar liking ratings could generate different emotion experiences. Consumers generally associated the most liked odorants with terms such as *fresh, crisp, natural,* and *modern*. Those odorants also were perceived to be suitable for most occasions, congruent with most personal

care products, and held high expectation of functional benefits. It can be concluded that pleasant smells positively influence consumer responses, regardless of which odors a particular group likes most.

Reference

Aarts, P. (2003). Fragrances with real impact. *Perfumer and Flavorist*, *28(5),* 34-49.

Bhumiratana, N., (2010). *The development of an emotion lexicon for the coffee drinking experience (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/handle/2097/7010.

Deliza, R., & Macfie, H.J.H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies*, *11,*103-128.

Edwards, M. (2008). *Fragrances of the World: Parfums du Monde 2008* (24th ed.). Fragrances of the World, Sidney.

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/153230175.html?page=2.

Fontaine, J.R., Scherer, K.R., Roesch, E.B., & Ellsworth, P.C. (2007). The world of emotions is not two-dimensional. *Psychological Science*, *18,* 1050–1057.

Gibson, E.L. (2006). Emotional influences on food choice: Sensory, physiological and psychological pathways. *Physiology & Behavior*, *89(1),* 53-61. DOI.10.1016/j.physbeh.2006.01.024.

Gleason-Allured, J. (2008, October). Scentworld 2008 report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist.com/events/coverage/31286474.html.

Gleason-Allured, J. (2010a, April). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93719369.html.

Gleason-Allured, J., & Grabenhofer, R. (2010, May 13). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93719369.html.

Gregory, S. (2012, December 5). Enhancing emotional consumer connections. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/manufacturing/packaging/Enhancing-Emotional-Consumer-Connections-182215351.html.

Grubow, L., & Kastner, A. (2011, December). Evolving gender stereotypes drive growth in Asian men's personal care. *GCI Magazine*. Retrieved from http://www.cosmeticsandtoiletries.com/formulating/category/menscare/134765353.html?page=1.

Harper, M., & Burns, L.M. (2012, January). Making a fragrance connection through color. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/138487989.html.

Haugtvedt, C.P., Kardes, F.R., & Herr, P.M. (2008). *Handbook of Consumer Psychology*. New York, NY: Psychology Press.

Hayden, N. (2009, December). Sun care: To scent or not to scent. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/suncare/78699012.html.

Herz, R.S. (2003). The effect of verbal context in olfactory perception. *Journal of Experimental Psychology: General*, 132, 595-606.

Higuchi, T., Shoji, K. and Hatayama, T. (2004), Multidimensional scaling of fragrances: A comparison between the verbal and non-verbal methods of classifying fragrances. *Japanese Psychological Research*, *46 (1),* 10–19. DOI: 10.1111/j.1468-5884.2004.00232.x.

Honkanen, P., Olsen, S. O., & Myrland, Ø. (2006). Preference-based segmentation: A study of meal preferences among Norwegian teenagers. Journal of Consumer Behaviour, 3, 235–250. doi: 10.1002/cb.137

Jellinek, P. (1951). *Die Psychologischen Grundlagen der Parfümerie*. Heidelberg: Alfred Hüthig Verlag.

Jellinek, J.S. (1992). Perfume classification: a new approach. In S. Van Toller and G.H. Dodd (Eds.), *Fragrance: The Psychology and Biology of Perfume* (pp. 229–242). London: Chapman and Hall.

Jellinek, P. (1997). The psychological basis of perfumery. In J.S. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed.) (pp.1-162). London: Chapman and Hall.

Kardes, F. R. (1999). *Consumer Behaviour: Managerial Decision Making*. Reading, MA: Addison-Wesley.

Kergoat, M., Giboreau, A., Nicod, H., Faye, P.,Diaz, E., Beetschen, M.A., Gerritsen, N., Meyer, T. (2010). Psychographic measures and sensory consumer tests: When emotional

experience and feeling-based judgments account for preferences. *Food Quality and Preference, 21,* 178–187.

King, S.C., & Meiselman, H.L. (2009). Development of a method to measure consumer emotions associated with foods. *Food Quality and Preference, 21*, 168-177.

Konstantinidis, I., Hummel, T., & Larsson, M. (2006). Identification of unpleasant odors is independent of age. Archives of Clinical Neuropsychology, 21, 615–621.

Lindqvist, A. (2012a). Perfume preferences and how they are related to commercial gender classifications of fragrances. *Chemosensory Perception*, *5(2),* 197-204. DOI: 10.1007/s12078-012-9119-7.

Lindqvist, A. (2012b). Preference and gender associations of perfumes applied on human skin. *Journal of Sensory Studies*, *27,* 490–497. DOI:10.1111/joss.12014.

MacFie, H.J.H., & Thomson, D.M.H. (1994). *Measurement of Food Preferences*. Glasgow, Scotland: Blackie Academic & Professional.

Martens, M., & Martens, H. (1986). Partial least squares regression. In J. R. Piggott (Ed.), *Statistical Procedures in Food Research* (pp. 293-359). London and New York: Elsevier Applied Science.

Milotic, D. (2003). The impact of fragrance on consumer choice. *Journal of Consumer Behaviour, 3,* 179–191. DOI: 10.1002/cb.131.

National Oceanic and Atmospheric Administration. (2012). *National Climatic Data Center (NCDC): The World's Largest Active Archive of Weather and Climate Data Producing and Supplying Data and Publications for the World*. Retrieved from http://www.ncdc.noaa.gov.

Penning, A. (2011, January 19). The sweet smell of your brand's success. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/114217909.html.

Porcherot, C., Delplanque, S., Raviot-Derrien, S., Le Calvé, B., Chrea, C., Gaudreau, N., Cayeux, I. (2010). How do you feel when you smell this? Optimization of a verbal measurement of odor-elicited emotions. *Food Quality and Preference, 21*, 938–947

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. DOI: 10.1016/j.foodqual.2011.07.006.

Rétiveau, A.N., (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRétiveau2004.pdf?sequence=1.

Rétiveau, A.N., Chambers IV, E., & Milliken, G.A. (2004). Common and specific effects of fine fragrances on the mood of women. *Journal of Sensory Studies*, *19,* 373–394. DOI: 10.1111/j.1745-459x.2004.102803.x.

Raudenbush, B. (2005).Positive effects of odorant administration on humans: a review. *A Sense of Smell Institute White Paper*.

Ruffolo, R. (2011, November). Just follow your nose! *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/132994293.html?mobi=y.

Schiffman, S. S., Miller, E. A., Suggs, M. S., & Graham, B. G. (1995b). The effect of environmental odors emanating from commercial swine operations on the mood of nearby residents. Brain Research Bulletin, 37, 369–375.

Schlich, P. (1995). Preference mapping: Relating consumer preferences to sensory or instrumental measurements. In P. Étiévant & P. Schreier (Eds.) (pp. 135-150). Dijon, France: INRA.

Schroiff, H.W. (1991). All's well that smells well? *Seminar on Fine Fragrances and Fragrances in Consumer Products Using Research and Development and Optimisation*, London, 13–15 November, E.S.O.M.A.R., Amsterdam.

Tanner, S. (2008, September). Materials: The scent of a winner. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/27917624.html.

Tyrimou, N. (2012, September). skin care market radiant for foreseeable future. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/skincare/167697355.html.

Wormuth, M., Scheringer, M. and Hungerbühler, K. (2005), Linking the use of scented consumer products to consumer exposure to polycyclic musk fragrances. *Journal of Industrial Ecology*, *9,* 237–258. DOI: 10.1162/1088198054084626.

Yenket, R. (2011). *Understanding methods for internal and external preference mapping and clustering in sensory analysis (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/8770/RenooYenket2011.pdf?sequence=9.

Yeshurun, Y., & Sobel, N. (2010). An odor is not worth a thousand words: from multidimensional odors to unidimensional odor objects. *Annual Review of Psychology*, *61,* 219-241, DOI: 10.1146/annurev.psych.60.110707.163639.

Zarzo, M., & Stanton, D.T. (2009). Understanding the underlying dimensions in perfumers' odor perception space as a basis for developing meaningful odor maps. *Attention, Perception, and Psychophysics*, *71,* 225–247.

Supplementary Results for Chapter 8

Supplementary Table 8.1 Sensory Characteristics of Five Odorant Samples and the Intensity Evaluated by a Fragrance Expert

Characteristics		Odorant sample (Type)				
		112 (Mossy woods/Citrus)	357 (Soft floral/Green)	413 (Floral/Citrus)	504 (Aromatic[Fougère])	958 (Oriental/Floral)
Overall strength		3.5	4.0	3.0	3.0	3.5
Fresh	Green		Green -2.0			
	Citrus	Lemon - 2.0		Lime -2.0	Lime -2.0	
	Aromatics					Lavender -2.0
Floral	Floral	Muguet -2.0		Violet -2.0	Geranium -2.0	
	Soft		Rose -2.0 Soapy -1.0	Soapy -1.0		
	Oriental					Anise -2.0
Oriental			Musk -2.0 Vanilla -3.0		Musk -3.0	Musk -2.0 Coconut -1.0
Woody	Woods	Woods -1.0				
	Dry				Cedar -1.0	Cedar -1.0
	Oriental	Pine -1.0				
	Mossy	Mossy -2.0				

* Intensity of each sensory characteristic was measured on a 5-pt numerical scale (0 = none and 5 = extremely high intensity)

Supplementary Table 8.2 Demographic Make-Up for Five Consumer Segments Classified Based on Liking Pattern of Five Odorant Samples

Individual difference		Consumer segment										Total	
		A		B		C		D		E			
		n = 50		n = 96		n = 27		n = 49		n = 18		N = 240	
		n	%	n	%	n	%	n	%	n	%	n	%
Gender	Female	25	50	54	56	11	41	22	45	11	61	123	51
	Male	25	50	42	44	16	59	27	55	7	39	117	49
Age group (year)	18-25	8	16	15	16	2	7	4	8	4	22	33	14
	26-35	23	46	43	45	14	52	15	31	6	33	101	42
	36-49	19	38	38	40	11	41	30	61	8	44	106	44
Personality pattern	Extreme	9	18	22	23	4	15	9	18	3	17	47	20
	Slightly extreme	6	12	17	18	7	26	9	18	4	22	43	18
	Slightly extreme and emotionally labile	7	14	19	20	7	26	13	27	1	6	47	20
	Emotionally ambivalent	12	24	17	18	4	15	7	14	3	17	43	18
	Emotionally ambivalent and labile	16	32	21	22	5	19	11	22	7	39	60	25

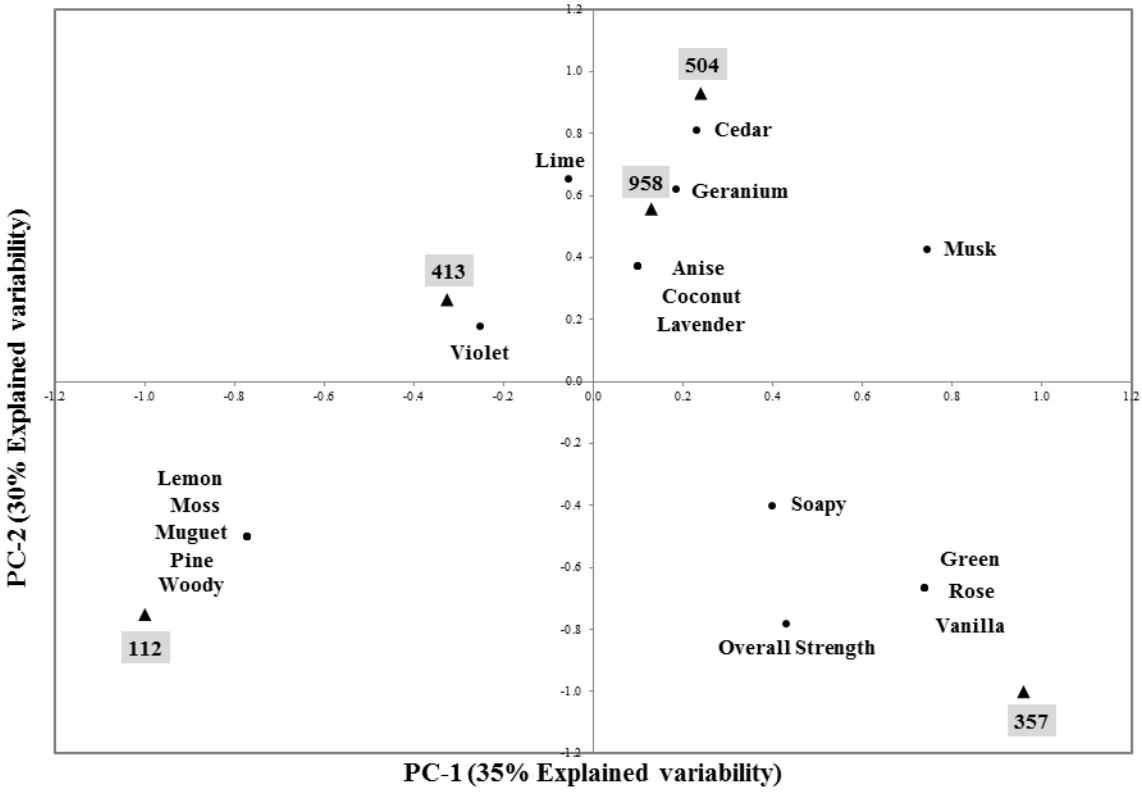
Supplementary Table 8.3 Correlation Coefficients and p-value Between Sensory Characteristics and Olfactory Liking of Five Consumer Segments on 5 Odorant Samples

Consumer segment	Overall strength	Fresh				Floral						Oriental			Woody			
		Green	Citrus		Aromatics	Floral			Soft		Oriental				Woods	Dry	Oriental	Mossy
		Green	Lemon	Lime	Lavender	Muguet	Violet	Geranium	Rose	Soapy	Anise	Musk	Vanilla	Coconut	Woody	Cedar	Pine	Mossy
A	0.44	0.20	0.34	-0.50	0.08	0.34	0.36	-0.98	0.20	0.46	0.08	-0.79	0.20	0.08	0.34	-0.74	0.34	0.34
	(0.4627)	(0.7484)	(0.5743)	(0.3867)	(0.9019)	(0.5743)	(0.5501)	**(0.0038)**	(0.7484)	(0.4385)	(0.9019)	(0.1083)	(0.7484)	(0.9019)	(0.5743)	(0.1562)	(0.5743)	(0.5743)
B	-0.87	-0.87	-0.13	0.62	0.25	-0.13	0.63	0.12	-0.87	-0.19	0.25	-0.30	-0.87	0.25	-0.13	0.30	-0.13	-0.13
	(0.0561)	*(0.0544)*	(0.8386)	(0.2694)	(0.6913)	(0.8386)	(0.2521)	(0.8464)	*(0.0544)*	(0.7534)	(0.6913)	(0.6279)	*(0.0544)*	(0.6913)	(0.8386)	(0.6254)	(0.8386)	(0.8386)
C	-0.11	-0.55	0.50	-0.28	0.39	0.50	-0.67	0.32	-0.55	-0.99	0.39	0.22	-0.55	0.39	0.50	0.59	0.50	0.50
	(0.8635)	(0.3414)	(0.3944)	(0.6464)	(0.5122)	(0.3944)	(0.2180)	(0.5959)	(0.3414)	**(0.0010)**	(0.5122)	(0.7201)	(0.3414)	(0.5122)	(0.3944)	(0.3000)	(0.3944)	(0.3944)
D	-0.43	-0.10	0.34	0.57	-0.94	0.34	0.30	0.39	-0.10	0.16	-0.94	-0.30	-0.10	-0.94	0.34	-0.45	0.34	0.34
	(0.4750)	(0.8698)	(0.5697)	(0.3196)	**(0.0192)**	(0.5697)	(0.6204)	(0.5154)	(0.8698)	(0.7926)	**(0.0192)**	(0.6219)	(0.8698)	**(0.0192)**	(0.5697)	(0.4525)	(0.5697)	(0.5697)
E	-0.49	-0.23	-0.87	0.56	0.42	-0.87	0.46	0.22	-0.23	0.19	0.42	0.35	-0.23	0.42	-0.87	0.52	-0.87	-0.87
	(0.4064)	(0.7119)	*(0.0534)*	(0.3303)	(0.4816)	*(0.0534)*	(0.4373)	(0.7189)	(0.7119)	(0.7619)	(0.4816)	(0.5632)	(0.7119)	(0.4816)	*(0.0534)*	(0.3642)	*(0.0534)*	*(0.0534)*

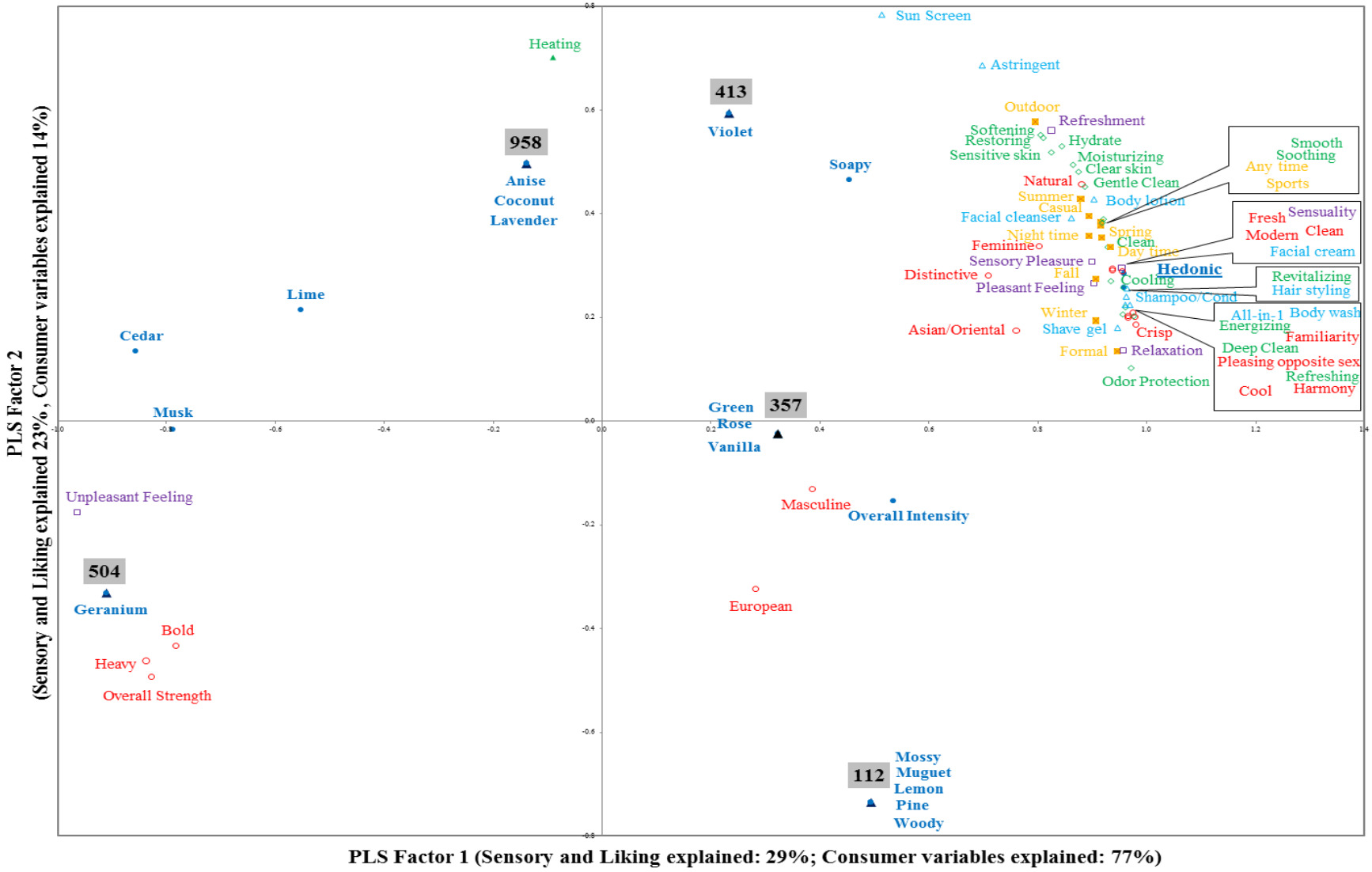
* Correlation coefficient presented are ranging within -1 and 1

** p-value presented within the parenthesis that is **bold** represented significant correlation ($p<0.05$)

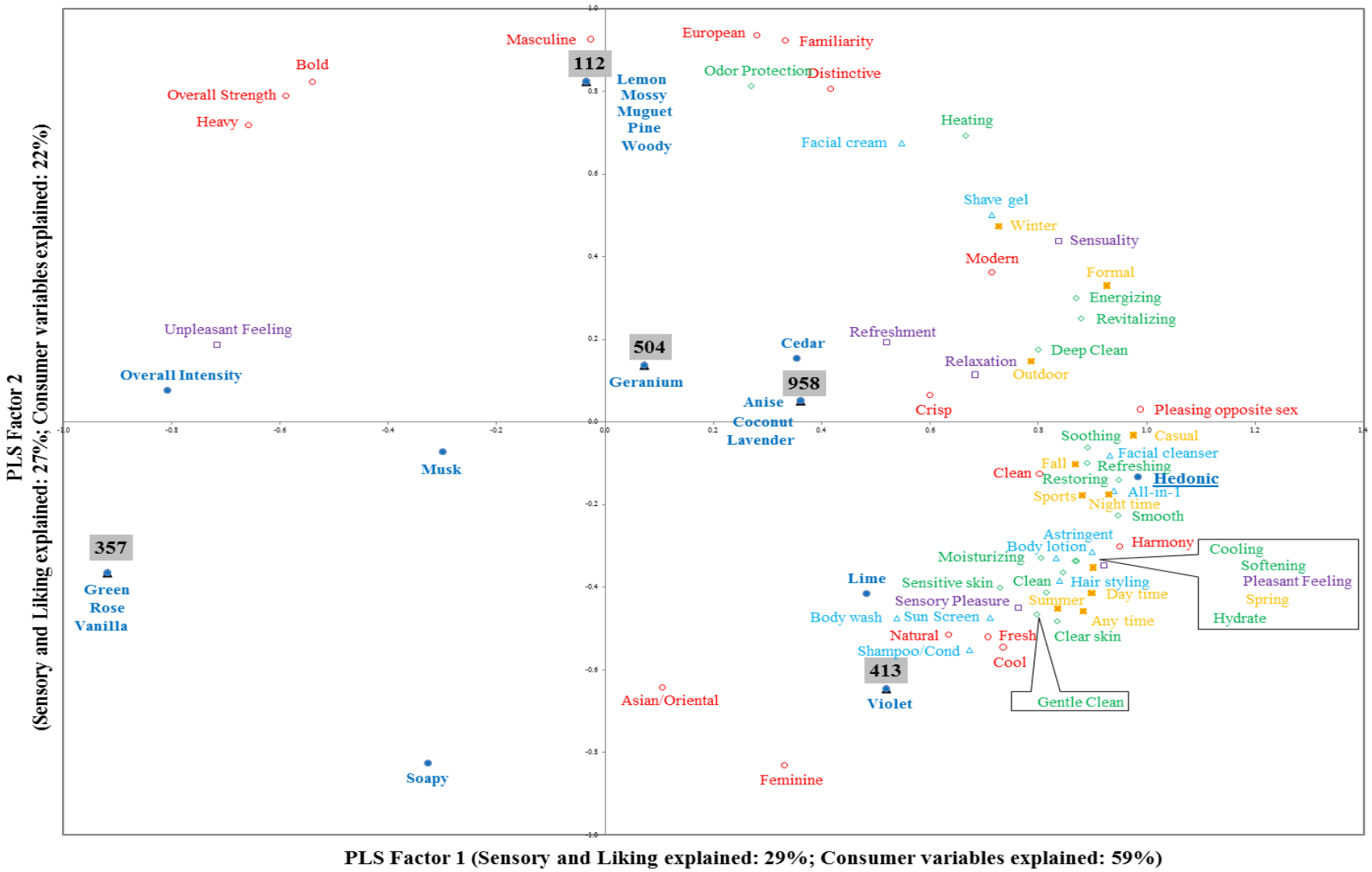
*** p-value presented within the parenthesis that is *italic* and underlined represented significant correlation ($p<0.10$)



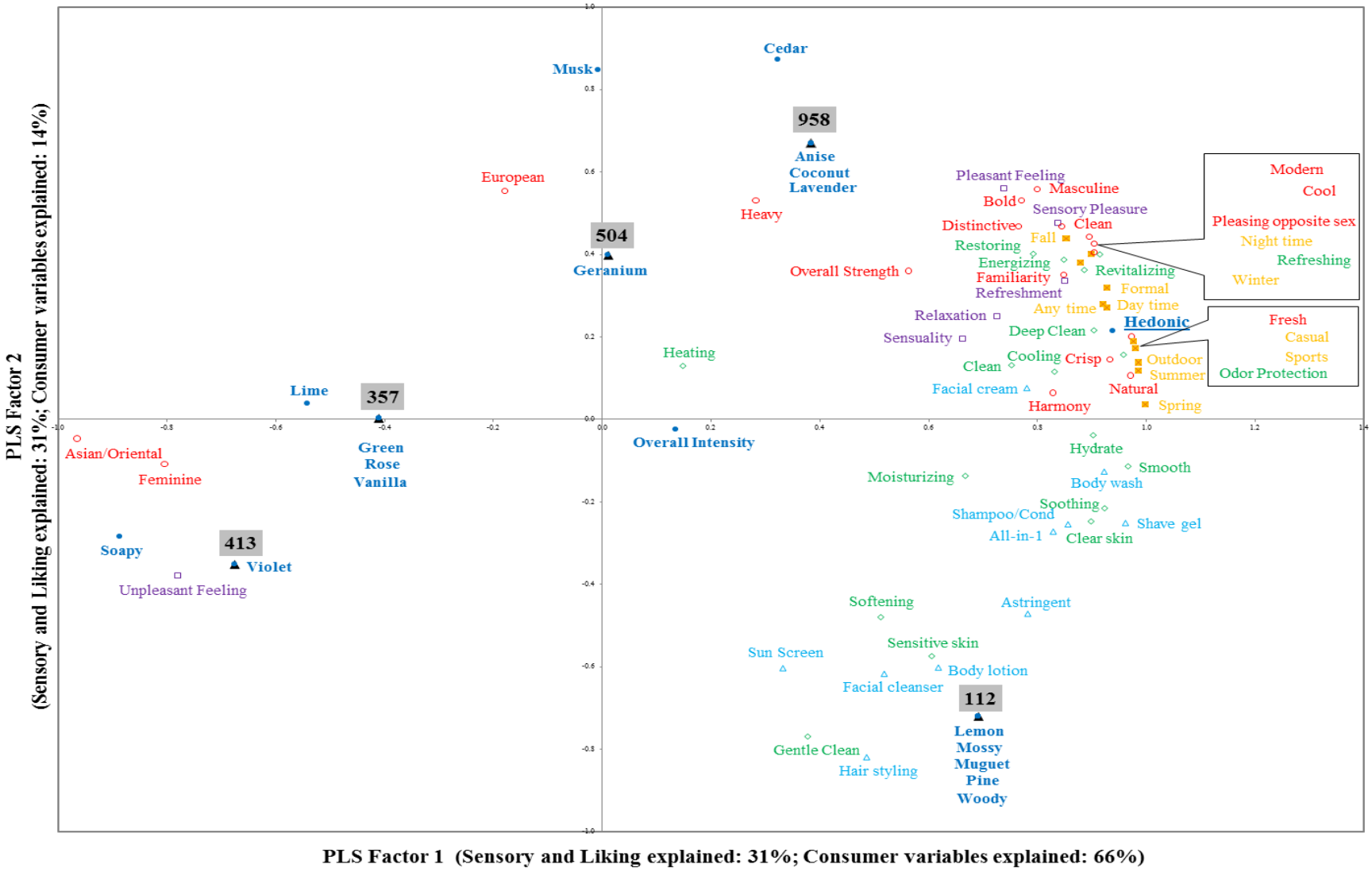
Supplementary Figure 8.1 **Sample and Attribute Plot Derived by Principal Components Analysis on sensory Profile Data of Five Odorant Samples.**



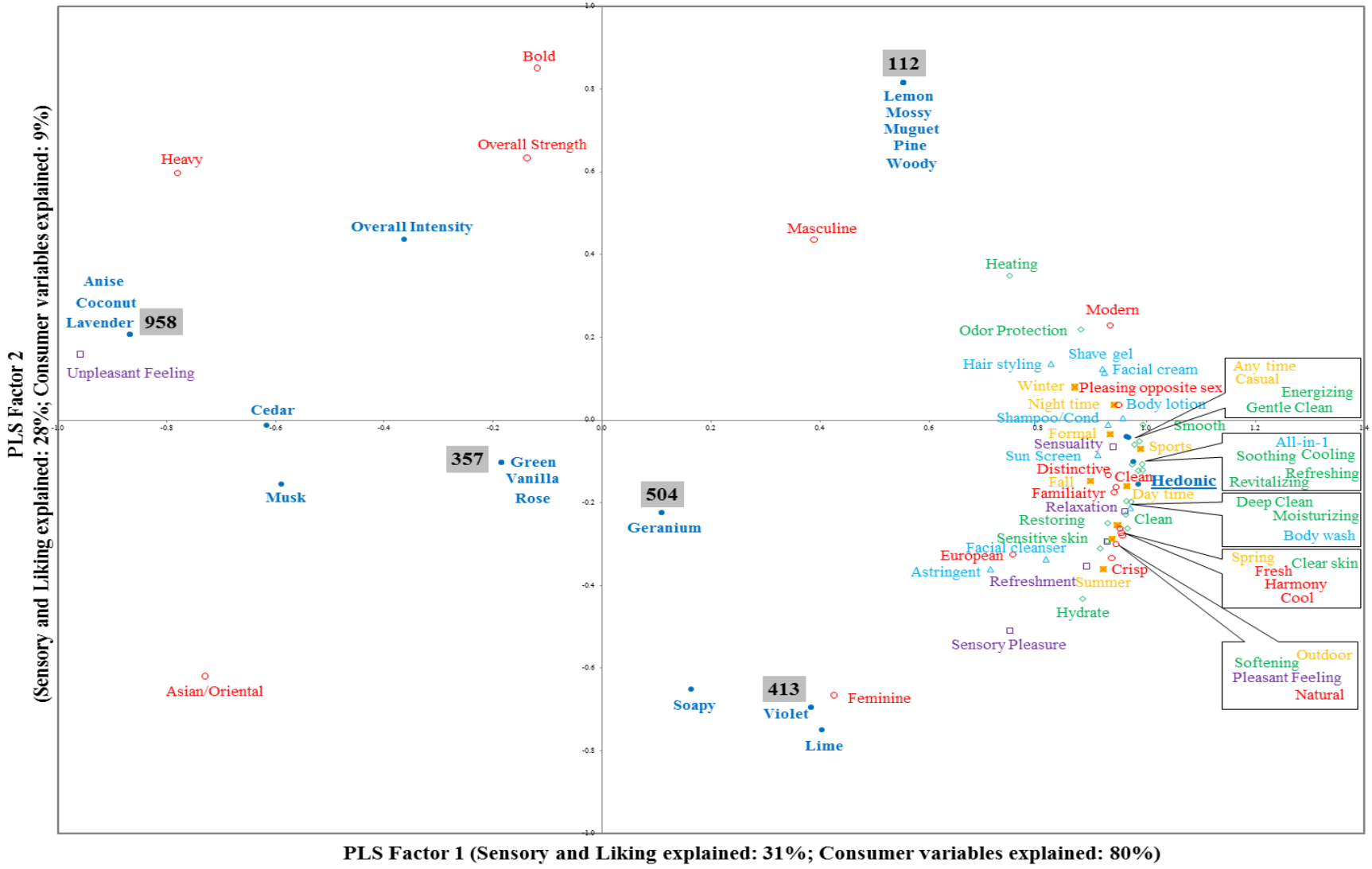
Supplementary 8.2 **Location of Odorant Samples on the First Two PLS Factors Relating Descriptive Terms and Liking Scores of Consumer Segment A (Consumers who Disliked Sample 504) to Other Response Variables**



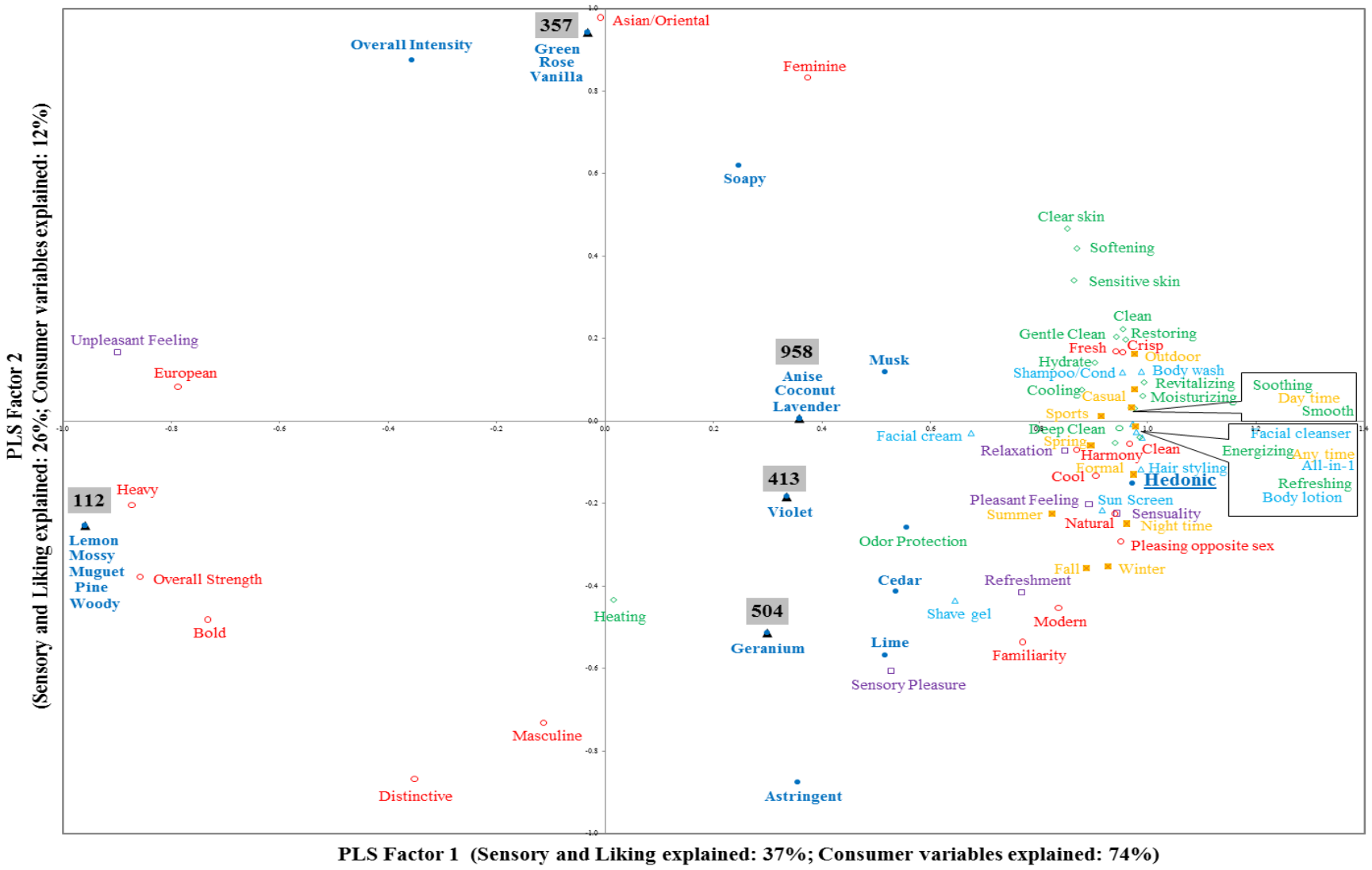
Supplementary 8.3 **Location of Odorant Samples on the First Two PLS Factors Relating Descriptive Terms and Liking Scores of Consumer Segment B (Consumers who Liked All Odorant Samples) to Other Response Variables**



Supplementary Figure 8.4 **Location of Odorant Samples on the First Two PLS Factors Relating Descriptive Terms and Liking Scores of Consumer Segment C (Consumers who Disliked Sample 357 and 413) to Other Response Variables**



Supplementary Figure 8.5 **Location of Odorant Samples on the First Two PLS Factors Relating Descriptive Terms and Liking Scores of Consumer Segment D (Consumers who Disliked Sample 958) to Other Response Variables**



Supplementary Figure 8.6 **Location of Odorant Samples on the First Two PLS Factors Relating Descriptive Terms and Liking Scores of Consumer Segment E (Consumers who Disliked Sample to Other Response Variables**

Chapter 9 - Effect of Olfactory Liking Patterns of Odorants on Associations between Consumer Description and Odorants

Abstract

Humans can detect thousands of odors; however, identifying or translating the impressions of odors into words is difficult. Researchers developed terms to identify and classify odor quality, e.g., a name of an odor, a word that describes an odor, or a word related to sensory and odor effect. Different individuals may smell the same odor but describe the characteristic of the smell differently. Hence, this research investigates how individuals use or associate these terms with odorants to help future researchers understand and apply these terms to communicate effectively to consumers.

The objectives of this study were to 1) examine how consumers associated sensory and consumer-related terms with odorants and 2) investigate if the terms related to liking.

Five odorants purposely created for men's personal care products were selected in this study. Two hundred forty consumers were classified into 5 different segments based on odorant acceptance patterns. The results demonstrated that acceptance had an effect on how consumers associated terms with smells. The consumers who had a different liking pattern associated terms with odorants differently. Some terms (e.g., *fresh* and *crisp*) were found to highly related to acceptance preference, whereas, terms such as *masculine* and *feminine* were found to be unrelated to consumer acceptance.

Introduction

Some scientists believe smell to be the most powerful emotional sense in humans (Ehrlichman & Halpern, 1988; Penning, 2011; Falk & Penning, 2012). The perception of smell can surpass other senses because of its direct connection with the limbic system that is

responsible for emotions (Herz & Engen, 1996; John, Christensen, & Boyden, 2006; LeDoux, 2007). Consequently, the sense of smell has been called "more subjective", whereas the senses of touch, sight, and hearing are more objective (John et al., 2006; Herz & Cupchik, 1995; Herz, 1997; Kant, 2006; Aspria, 2009). Scent has an ability to directly establish hedonic response and mood as well as eliciting memories (Goel & Grasso, 2004; John et al., 2006; Falk, 2007; Willander & Larsson, 2007; Walker, 2009; Penning, 2011; Ruffolo, 2011).

Humans can detect about 5,000-10,000 distinct odors (Buck & Axel 1991; Zarzo, 2007; Gilbert, 2008). However, the ability to identify or translate the smell impression into words is more difficult than translating impressions of sight and hearing (Lawless & Engen 1977; Guerer, 2002; Stevenson & Boakes, 2003) because odor descriptions are influenced by personal biases of experience, culture, biology, gender, subjectivity, and social constructs (Richardson & Zucco, 1989; Herz, Beland, & Hellerstein, 2004; Donna, 2009; Zarzo, 2007; Gilbert, 2008; Zarzo & Stanton, 2009). This is especially difficult from a consumer perspective where words can mean many different things (Gleason-Allured 2010a).

The development of odor descriptors is essential for a sensory scientist because it provides a standard of communication for a research team (Zarzo & Stanton, 2009), clarifies consumer preferences (Nute, Macfie, & Greenhoff, 1988), aids in communication of complex mixtures of odorants among researchers, and benefits marketing teams (Donna, 2009; Zarzo & Stanton, 2009). It also provides a standard of communication for researchers, retailers, and consumers (Jellinek, 1992; Zarzo & Stanton, 2009; Donna, 2009).

The understanding of olfactory elements and how consumers define notes are challenging. The terms can be a common name that fits perceptual impressions of each odor (i.e., *lavender*, *orange*, *musk*, etc.; Higuchi, Shoji, & Hatayama, 2004), adjective terms which are

sufficient to accurately describe fragrance characteristics (i.e., *citrusy*, *cool-minty*, *floral*, *fruity*, *green*, *herbal*, *spicy*, and *woody*; Rétiveau, 2004), adjectives related to intensity of the five senses (i.e., *mild*, *soft*, *sweet*, *strong*, *intense*, *cool*, *clear*, and *sour;* Higuchi et al., 2002), or descriptions of odor physiological and psychological effects (i.e., *modern*, *sexy*, *sultry*, *indulgent*, *fresh*, and *natural*) (Jellinek, 1992; Gleason-Allured, 2008; Zarzo & Stanton, 2009; Gleason-Allured, 2010b; Falk & Penning, 2012). Many of these terms often are found in advertisements and journal articles (Gleason-Allured, 2008; Gleason-Allured, 2010b; Falk & Penning, 2012).

The sense-related adjective and description of odor effect often are subjective, ambiguous, and difficult to interpret. Thus, a study of how these terms are associated with fragrances and consumers would enable researchers to understand the terms and appropriately apply them to communication with consumers. This study's objectives were to 1) to investigate how consumers associated sensory and consumer-related terms with odorant samples, and 2) investigate if consumers associated these terms with their acceptance of scents.

Materials and Methods

Odorant Selection

To reduce the variability of gender association category of fragrance, only the masculine odorants were focused on this study. The odorant samples were selected from a pool of odorant samples representing a wide spectrum of masculine fragrances used for personal care products. Three personal care experts screened the samples. Researchers selected 4 representative odorant samples and a commercially available cologne for this study. The samples had olfactory characteristics that smelled as different as possible from each other. Additionally, each sample had diverse characteristics that covered at least 2-3 subfamilies in Edward's fragrance wheel (Edwards, 2008) (Table 9.1).

Table 9.1 Selected Odorant Samples and their Class and Description

Odorant type	Sample	Edwards' classification	Description
Odorant purposely made for personal care product	112	Mossy woods - Citrus	Chypre: moss, citrus, floral, woody
	357	Soft floral - Green	Soapy, vanilla, musk, rose
	413	Floral-Citrus	Lime, violet
	958	Oriental-Floral	Lavender, coconut, anise, musk
Commercial cologne	504	Aromatic	Fougère: geranium, cedar, lime, musk

Sample Preparation

Throughout the study all odorant bottles were stored at room temperature. A 0.5 mL sample of each odorant was transferred on a cotton swab (Qtips®, Uniliver, USA) using a disposable 1 mL tuberculin syringe (sterilized) (Fisher Scientific Inc., PA). The cotton swaps were pre-cut in half, length wise (4 cm). The scented cotton swab then was placed with the swab side down in an evaluation container and labeled with a 3-digit code. The type of container used in this study was an amber vial screw-thread bottle with a black screw-top cap and a white liner (3.7 mL) (Fisher Scientific Inc., PA). Each container was tightly closed immediately after the scented swab was inserted.

All samples were packed individually in a clear bubble bag with a lip and tape (3.5x4 in) (Staple®, USA) to protect from damage. Once each sample was packed in a bag, a label having a letter "A" was placed onto a bag to represent the first sample for evaluation. The other labels (B, C, D, and E), which represented evaluation order from 2^{nd} to 5^{th}, were placed on samples by the assigned presentation order according to the William-modified Latin square design (Meilgaard, Civile, & Carr, 2007). All five samples were packed in a postage box and sent out to consumers using the United States Postal Office (USPS). The sample set was assumed to arrive at the destination within 1-3 business days.

The test was conducted when the average temperature across country was at the range of 42-56 °F (National Oceanic and Atmospheric Administration [NCDC], 2012). This information provided assurance that the fragrance samples had not deteriorated during transport.

Respondents

A total of 240 consumers aged 18-49 years old, 49% male, 51% female, participated. Male participants were consumers who used cologne, fragrance, or fragranced personal care products (e.g., deodorants, shave gel/cream, shave balm, body wash, etc.) and female consumers were participants who liked the smell of cologne, fragrance, or personal care products on men or find themselves attracted to a person who uses these products.

Internet Survey

Prior to the sample shipment an email was sent to target consumers informing them about their qualification. After the samples were shipped out each consumer received another email notifying them about the package they were to receive and provided the test schedule for 5 odorant samples. The test schedule indicated the dates to complete each sample. The consumers were asked to evaluate each sample anytime within the 3 days at their home. They also were asked to evaluate another odorant sample in the following 3 day periods. The online-survey for each sample was available only on the specified dates. Consumers could not revisit the survey, and they were not allowed to do a make-up test if missed. The test was available for 2 weeks for the consumers to complete.

Questionnaires

Consumers were asked to sniff an odorant sample and indicate how much they liked the smell of that sample. After smelling the sample they were asked a forced-choice question as to whether the odorant they smelled was for males, females, or both genders (unisex).

The survey continued by asking consumers to indicate their level of association to sensory and consumer-related terms from a checklist consisting of 16 sensory and consumer-related terms (e.g., bold, heavy, modern, crisp, familiar, natural, and distinctive), generated and collected from previous studies (Jellinek, 1992; Higuchi et al., 2004; Gleason-Allured, 2008; Zarzo & Stanton, 2009; Falk & Penning, 2012; Lindqvist, 2012a; Porcherot et al., 2012). The respondents were asked to indicate the level of terms associated with an odorant using a numerical scale from 1 = not at all, to 5 = extreme.

Data analysis

Consumer Segmentation Using Liking Pattern

The hedonic score of all five odorants rated by each consumer were subjected to Ward's hierarchical clustering method using PROC CLUSTER of SAS® (version 9.2; SAS Institute, Cary, NC, USA). Researchers applied the clustering method to classify liking patterns of respondents. Hierarchical dendogram and cubic clustering criterion were plotted to assist in decision making for the numbers of consumer segments based on the similarity of liking patterns.

For each consumer segment, liking data were analyzed using a GLIMMIX model (SAS, 1998) where an odorant, a consumer cluster, and an interaction of odorant by consumer cluster were treated as fixed effects. A respondent within a cluster was treated as a random effect.

Relationship of Olfactory Preference and Consumer Perception of Terms Associated with Odorant Samples

The level of associations of sensory and consumer-related terms for respondents within all consumer clusters were analyzed by Analysis of Variance (AOV) using the GLIMMIX procedure at the 5% level of significance (SAS®). The odorant, consumer segment, and

interaction of odorant by consumer segment were used as fixed effects. The respondent was included in the model as a random effect. Mean separation tests (multiple t-tests) were carried out to compare the means if a significant difference existed.

Mean scores for variables (sensory and consumer-related terms) obtained from consumer segments were labeled with a sample code (112, 357, 413, 504, and 958) and a letter represented each consumer segment (A, B, C, D, and E). For example, the code 112-A represented the sample 112 that was evaluated by consumers from segment A. The mean responses of all odorant samples from all consumer clusters were subjected to the Unscrambler® 10.2 (CAMO Software Inc., Woodbridge, NJ, USA) for conducting Principal Component Analysis (PCA). The columns represented collected variables where the rows represented odorant samples. The PCA, using a correlation matrix, was used for generating a perceptual map for sensory and consumers-related terms associated with the five odorants.

Correlation Analysis of Odorant Liking toward a Set of Terms Associated with Odorant Samples

Researchers calculated Pearson correlation coefficients using the PROC CORR function (SAS ®) to investigate correlations between odorant liking scores of all five consumer segments and their association level of sensory and consumer-related terms at a 95% confidence interval. Terms that highly correlated to odorant liking ($r \geq |90|$) were removed from the data set to prevent them from biasing further analysis by including multiple collinear terms that basically were used by consumers as surrogates for liking.

Relationship of Hedonicity to Sensory and Consumer-Related Terms of Odorant Samples

For each odorant sample, the mean scores of odorant liking and association level of sensory and consumer-related terms of all five consumer segments were subjected to the

Unscrambler® 10.2 (CAMO Software Inc., Woodbridge, NJ, USA) for conducting Partial Least Square Regression (PLSR) to investigate the relationship between two sets of variables (Martens & Martens, 1986). The sensory and consumer-related terms (independent variables, X-variables) were used as predictors of an odorant liking (dependent variable, Y-variable). In addition, all variables were standardized prior to the PLSR and a correlation analysis to eliminate differences in scale types.

Results and Discussion

Consumer Segmentation on Liking Patterns

Consumer segmentation was generated based on cluster analysis (Ward's hierarchical clustering method). Cluster analysis classified the 240 consumers into 5 segments that had different appreciation patterns toward the five odorant samples. The degrees of appreciation toward all five odorant samples were rated by consumers in each segment (Table 9.2).

Table 9.2 Liking Scores of Five Consumer Segments on Five Odorant Samples

Consumer segment	N	Sample/Description					p-value
		112	357	413	504	958	
		Mossy woods/ Citrus	Soft floral/ Green	Floral/ Citrus	Aromatic (Fougère)	Oriental /Floral	
A	50	7.00 ^{a}	6.58 ^{ab}	7.06 ^{a}	3.10 ^{c}	6.22 ^{b}	<0.0001
B	96	7.25 ^{b}	6.77 ^{c}	7.74 ^{a}	7.41 ^{ab}	7.49 ^{ab}	<0.0001
C	27	7.11 ^{a}	4.89 ^{b}	4.63 ^{b}	6.74 ^{a}	6.89 ^{a}	<0.0001
D	49	6.82 ^{a}	5.65 ^{b}	6.71 ^{a}	6.94 ^{a}	3.47 ^{c}	<0.0001
E	18	2.39 ^{c}	4.22 ^{b}	6.17 ^{a}	5.50 ^{ab}	6.06 ^{a}	<0.0001

*Acceptance scores (liking) were evaluated using a 9-point Acceptance scale where 1 = dislike extremely, and 9 = like extremely. Least square means with the same letter within a row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test.

Comparison of Overall Ratings of Five Consumer Segments

A total of 16 sensory and consumer-related terms for odorant samples were presented to consumers. Consumers in all segments associated the terms differently with each of the five odorant samples ($p<0.05$). The association level of most terms were found to be different across consumer segments ($p<0.05$). For example, the consumers in segment B generally provided higher responses than the other segments ($p<0.05$). However, consumers in segment E provided lower responses than consumers from other segments ($p<0.05$) (Supplement table 9.1).

In addition, consumers from different segments perceived the same odorant sample to be different by associating it with the given sensory and consumer-related terms ($p<0.05$): within the same odorant sample, most terms were found to be different among consumer segments.

Consumer Perception of Terms Associated with Odorant Samples

The sensory and consumer-related terms of odorant samples are illustrated on a PCA map which separates odorant samples from each other according to how consumers associated the terms with the samples. Samples that are close to one another were considered to have similar association levels toward sensory and consumer-related terms (Figure 9.1).

From PCA the explained variance of variables by using the first two dimensions were a 92% explained variance, where the first two principal components (PCs) accounted for 74% and 18%, respectively (Figure 9.1).

In general, the PC map demonstrated that consumers from all five segments associated most terms with many samples as most terms and most samples were located on the right side of the map. PC1 was associated with terms such as *clean, cool, crisp, fresh, harmony, familiarity,* and *natural*. The samples located on the right side of the map are those samples consumers

associated with those terms. In contrast, samples that fell to the left side of the map were least associated with the terms studied (Figure 9.1).

The PC2 separated samples based on how the odorant samples associated with terms such as *bold, heavy, masculine,* and *feminine*. The scents that consumers associated with the terms *bold, heavy,* and *masculine* were located on the top part of the map. The scents that were the least associated with *bold, heavy,* and *masculine* but highly associated with *feminine,* were located on the lower part of the map.

The terms *Asian/Oriental* and *European* were not found to have high associations toward the odorant samples for all five consumer segments as they were located close to the center of the map.

It is clear from the map that the same sample is not associated with the same terms depending on what consumer segment scored the samples and terms. For example, consumer in liking segment E suggest that samples 112 and 347 have little relationship to the terms evaluated. Similarly consumers in liking segment A, D, and C, do not related samples 504, 985, or 413 respectively with those terms. However for other liking segments, those same samples clearly are perceived to be related to the terms measured.

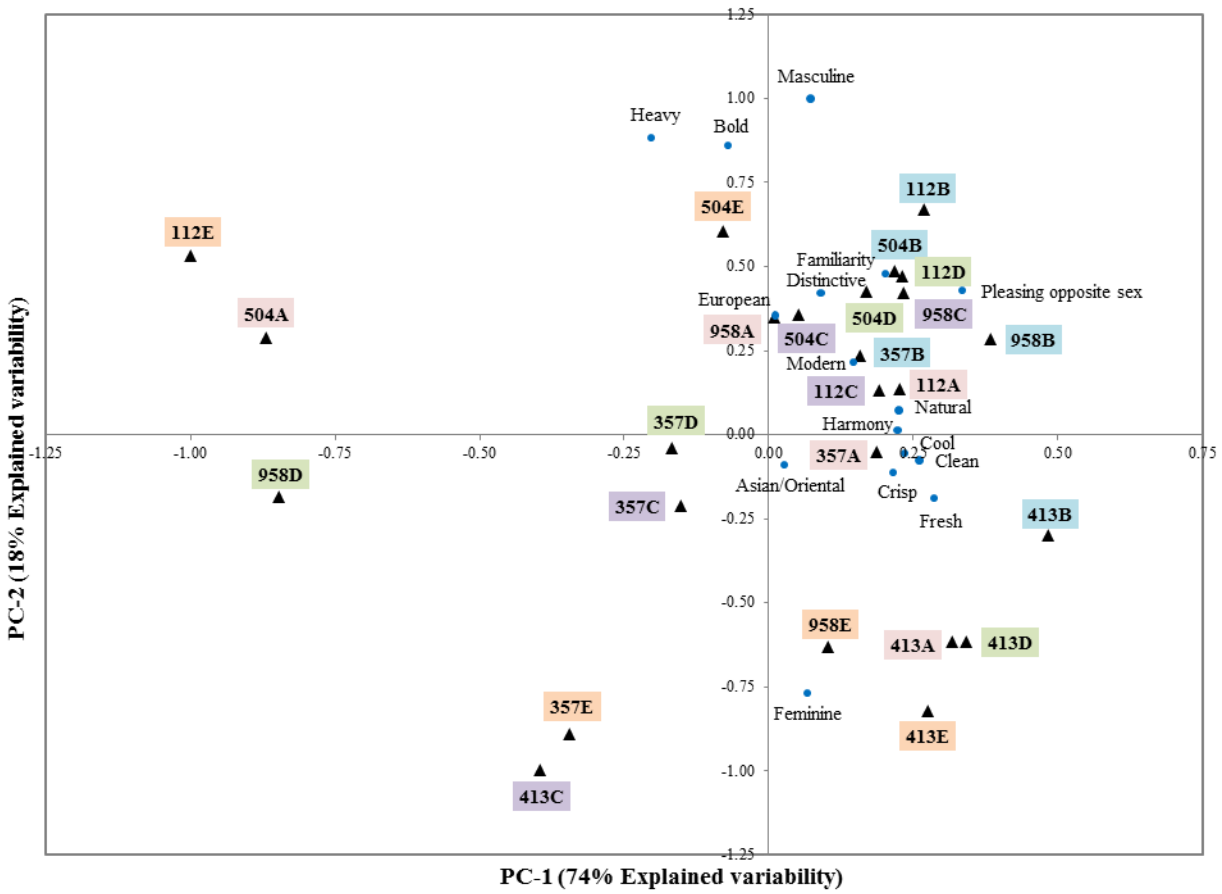


Figure 9.1 **Principal Component Map Describes Relationships between Sensory and Consumer-Related Terms of Five Odorant Samples Evaluated by Five Consumer Segments (A-E)**

Relationship of Hedonic Score to Sensory and Consumer-Related Terms

Correlation analysis revealed the relationship between the 16 sensory and consumer-related terms and odorant liking. Nine terms (*modern, clean, cool, crisp, fresh, harmony, familiarity, natural,* and *pleasing the opposite sex*) were found to be highly correlated to odorant liking ($r \geq 0.90$) (Table 9.3). The high correlations between odorant liking and these nine terms were interpreted as consumers associating the odorant samples they liked with the nine highly correlated terms, and vice versa. These terms may in fact be highly related based on these 5 products or they simply may serve as consumer surrogate terms for liking for men's fragrances

in general. Previous research suggests that some terms, such as “fresh”, are the odor qualities participants primarily prefer (Lindqvist, 2012a).

Table 9.3 Correlation Coefficient and p-value of Sensory and Consumer-Related Terms on Odorant Liking Obtained from Five Consumer Segments Evaluated Five Odorant Samples

Sensory and consumer term	Correlation coefficient	p-value
Bold	-0.24	0.2398
Asian/Oriental	0.34	0.1017
Clean	0.93*	<.0001
Cool	0.94*	<.0001
Crisp	0.91*	<.0001
Distinctive	0.7	0.0001
European	0.15	0.4822
Familiarity	0.90*	<.0001
Feminine	0.21	0.3246
Fresh	0.94*	<.0001
Harmony	0.93*	<.0001
Heavy	-0.64	0.0006
Masculine	0.48	0.0154
Modern	0.92*	<.0001
Natural	0.94*	<.0001
Pleasing the opposite sex	0.98*	<.0001

Seven terms, *bold, heavy, distinctive, European, Asian/Oriental, masculine,* and *feminine* were not highly correlated with odorant liking scores ($r = |24\text{-}70|$), showing that those term are not directly tied to liking and consumers may associate these terms differently with odorants depending on other criteria. The terms associated with gender were not found to have an effect on preference, which was similar to previous research (Lindqvist, 2012b) that found neither gender of individuals, nor commercial gender categorization of perfumes, was important to participants’ perception. Because these seven terms are not associated directly with liking, they

were used to further investigate how consumers from different segments associated terms to the same odorant sample.

In general, consumers from different segments associated different terms with the same odorant (Table 9.4). For example, after consumers smelled the odorant sample 112, consumers in segment A, C, and D associated *feminine* with this sample more than the other segments. On the other hand, consumers in segment B associated the odorant 112 with the term *masculine, distinctive,* and *Asian/Oriental,* and consumers in segment E associated *European, bold,* and *heavy* with the odorant sample (Figure 9.2).

Table 9.4 Summary of Terms Consumers in Each Segment Found to be Highly Associated with Odorant Samples

Odorant		Consumer Segment				
Code	Description	A	B	C	D	E
112	Mossy woods/ Citrus	Feminine	Masculine, distinctive, Asian/oriental	Feminine	Feminine	European, bold, heavy
357	Soft floral/Green	Masculine	Masculine, bold, distinctive	Asian/oriental , heavy	Asian/Oriental, heavy, masculine, bold, distinctive	Feminine
413	Floral/Citrus	Distinctive, masculine	Feminine, bold, European, Asian/Oriental	Heavy	Feminine, bold, European, Asian/oriental	Distinctive
504	Aromatic (Fougère)	Bold, heavy	Masculine	Masculine	Distinctive, Asian/oriental, European, feminine, masculine	Masculine
958	Oriental/Floral	Distinctive, European, masculine, bold	Distinctive, European, masculine, bold	Distinctive, European, masculine, bold	Heavy	Feminine

The same term could be related positively or negatively to consumer odorant liking. For example, the terms *bold* and *heavy* were the terms consumers in segment E associated with odorant 112 that they did not like. In contrast, the consumers from segment A, B, C, and D who

liked the smell of this odorant found those terms to be the least associated with the preferred odorant. However, even within those segments that liked odorant 112, the term bold was differentially associated with the term. For example consumers in liking segment B were more likely to identify odorant 112 as bold than consumers in segment A or C.

Results indicated that 22% of the consumers perceived an odorant sample to be in a female or unisex category (sample 504). Approximately 50% of consumers categorized the samples 357 and 413 to be for females or both sexes (43% and 56% of the consumers for samples 357 and 413, respectively) (Table 9.5). Therefore, the term *feminine* was highly associated with *masculine* and positively correlated to odorant liking in sample 413, especially in consumer segments B and D (Supplementary figure 9.2 and 9.4). This finding indicated that consumers were not biased towards the terms *masculine* and *feminine* even though participants at the beginning of the study were asked whether they were either an actual user or had an appreciation toward men's cologne or scented personal care products. This phenomenon showed that gender association of masculinity and femininity were not always the two opposites on a binary polarization in the same odor dimension, as it has been suggested in previous studies (Bussey & Bandura, 1999; Riley, 2003). The finding also proved that gender association of odors demonstrated a continuum of overlapping odorant/perfumes rather than two distinct clusters of feminine against masculine scents (Figures 9.2) (Jellinek, 1992; Zarzo, 2008; Zarzo & Stanton, 2009; Lindqvist 2012a).

Table 9.5 Gender Categorization of Five Odorant Samples (Forced Choice)

Odorant		Gender categorization (Percentage)		
Code	Description	Male	Female	Unisex
112	Mossy woods/ Citrus	74	6	20
357	Soft floral/ Green	57	13	30
413	Floral/Citrus	44	21	35
504	Aromatic (Fougère)	78	3	19
958	Oriental/Floral	70	6	24

Conclusion

Liking had an effect on how consumers associated terms with a smell. This study demonstrated that consumers who had different odorant liking patterns associated consumer-related terms differently with the same odorants. Some consumers highly associated terms, e.g., *bold* and *heavy* with an odorant sample while other consumers who had different pattern of acceptance found those terms to be the least associated with the same odorant.

References

Aspria, M. (2009, January 19). Sex smells: odor, sexuality, and the erotic imaginary. *Scented Pages Perfume, Culture, and History*. Retrieved from http://scentedpages.com/pdf/aspria.pdf

Buck, L., & Axel, R. (1991). A novel multigene family may encode odorant receptors: A molecular basis for odor recognition. *Cell, 65(1)*, 175–187.

Bussey, K., Bandura, A. (1999). Social cognitive theory of gender development and differentiation. *Psychological Review*, *106,* 676–713.

Donna, L. (2009, December). Fragrance perception is everything relative? *Perfumer and Flavorist*. *34,* 26-35.

Edwards, M. (2008). *Fragrances of the World: Parfums du Monde 2008* (24th ed.). Fragrances of the World, Sidney.

Ehrlichman, H., & Halpern, J.N. (1988). Affect and memory: Effects of pleasant and unpleasant odors on retrieval of happy and unhappy memories. *Journal of Personality and Social Psychology, 55,*769-79.

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/153230175.html?page=2

Falk, J. (2007, May). Emotional packaging. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/7320046.html

Gilbert, A. N. (2008). *What The Nose Knows: The Science of Scent in Everyday Life.* New York: Harper Perennial.

Gleason-Allured, J. (2008, October). Scentworld 2008 report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist.com/events/coverage/31286474.html

Gleason-Allured, J. (2010a, April). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93719369.html

Gleason-Allured, J. (2010b, January). Fine fragrance's new reality. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93722124.html?page=2

Goel, N., Grasso, D.J. (2004). Olfactory discrimination and transient mood change in young men and women: variation by season, mood state, and time of day. *Chronobiology International*, *21***,** 691-719.

Guerer, A. L. (2002). Olfaction and cognition: A philosophical and psychoanalytical view. In C. Rouby (Ed.), *Olfaction, Taste, and Cognition*. Cambridge, New York: Cambridge University Press.

Herz, R. S. (1997). The effects of cue distinctiveness on odor-based context dependent memory. *Memory & Cognition*, *25*, 375-380.

Herz, R. S., Beland, S. L., & Hellerstein, M. (2004). Changing odor hedonic perception through emotional associations in humans. *Journal of Comparative Psychology*, *17,* 315-339.

Herz, R. S., & Engen, T. (1996). Odor memory: Review and analysis. *Psychonomic Bulletin & Review, 3,*300-313.

Herz**,** R. S., & Cupchik, G. C. **(**1995**).** The emotional distinctiveness of odor-evoked memories. *Chemical Senses, 20,* 517-528.

Higuchi, T., Shoji, K., & Hatayama, T. (2002). A psychological study of sense-descriptive adjectives for characterizing the fragrance. *Japanese Journal of Emotional Psychology*, *8,* 45–59. (In Japanese with English summary.).

Higuchi, T., Shoji, K. and Hatayama, T. (2004), Multidimensional scaling of fragrances: A comparison between the verbal and non-verbal methods of classifying fragrances. *Japanese Psychological Research*, *46*(1), 10–19. doi: 10.1111/j.1468-5884.2004.00232.x

Jellinek, J.S. (1992). Perfume classification: a new approach. In S. Van Toller and G.H. Dodd (Eds.), *Fragrance: The Psychology and Biology of Perfume* (pp. 229–242). London: Chapman and Hall.

John, T. V., Christensen, C., & Boyden, J. (2006). The benefits of fragrance materials: A magazine article. *Perfumer and Flavorist*, *28*(6), 30-43.

Kant, I. (2006), *Anthropology from a Pragmatic Point of View*. Cambridge/New York: Cambridge University Press.

Lawless, H., & Engen, T. (1977). Associations to odors: Interference, mnemonics, and verbal labeling. *Journal of Experimental Psychology: Human Learning and Memory, 3(1),* 52–59.

LeDoux, J. (2007). The amygdala. *Current Biology*, *17,* 868–874.

Lindqvist, A. (2012a). Perfume preferences and how they are related to commercial gender classifications of fragrances. *Chemosensory Perception*, *5*(2), 197-204. doi: 10.1007/s12078-012-9119-7

Lindqvist, A. (2012b). Preference and gender associations of perfumes applied on human skin. *Journal of Sensory Studies*, *27,* 490–497. doi:10.1111/joss.12014.

Martens, M., & Martens, H. (1986). Partial least squares regression. In J. R. Piggott (Ed.), *Statistical Procedures in Food Research* (pp. 293-359). London and New York: Elsevier Applied Science.

Meilgaard, M., Civile, G. V., & Carr, B. T. (2007). *Sensory Evaluation Techniques (4th ed.)*. Florida, USA: CRC Press.

National Oceanic and Atmospheric Administration. (2012). *National Climatic Data Center (NCDC): The World's Largest Active Archive of Weather and Climate Data Producing and Supplying Data and Publications for the World*. Retrieved from http://www.ncdc.noaa.gov

Nute, G. R., Macfie, H. J. H., & Greenhoff, K. (1988). Practical application of preference mapping. In D. M. H. Thomson (Ed.), *Food Acceptability* (pp. 377-386). London: Elsevier.

Penning, A. (2011, January 19). The sweet smell of your brand's success. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/114217909.html

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. doi: 10.1016/j.foodqual.2011.07.006

Rétiveau, A. N. (2004). *Individual differences and the perception of complex scents (Doctoral dissertation).* Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRétiveau2004.pdf?sequence=1

Richardson, J. T.E., & Zucco, G. M. (1989). Cognition and olfaction: A review. *Psychological Bulletin*, *105,* 352-360.

Riley, S. C. E. (2003). The management of the traditional male role: A discourse analysis of the constructions and functions of provision. *Journal of Gender Studies*, *12,* 99–113.

Ruffolo, R. (2011, November). Just follow your nose! *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/132994293.html?mobi=y

Stevenson, R.J., & Boakes. R.A. (2003). A mnemonic theory of odor perception. *Psychological Review, 110(2),*340–364, doi: 10.1037/0033-295X.110.2.340.

Walker, K. (2009, August 14). Natural instincts: Global trends in women's fragrances. Perfumer and Flavorist. Retrieved from http://www.perfumerflavorist.com/fragrance/trends/53235747.html

Willander, J., & Larsson, M. (2007). Olfaction and emotion: the case of autobiographical memory. *Memory and Cognition*, *35(7),* 1659-1663.

Zarzo, M. (2007). The sense of smell: Molecular basis of odorant recognition. *Biological Reviews*, *82,* 455–479.

Zarzo, M. (2008). Relevant psychological dimensions in the perceptual space of perfumery odors. *Food Quality and Preference*, *19,* 315–322.

Zarzo, M., & Stanton, D. T. (2009). Understanding the underlying dimensions in perfumers' odor perception space as a basis for developing meaningful odor maps. *Attention, Perception, and Psychophysics*, *71,* 225–247.

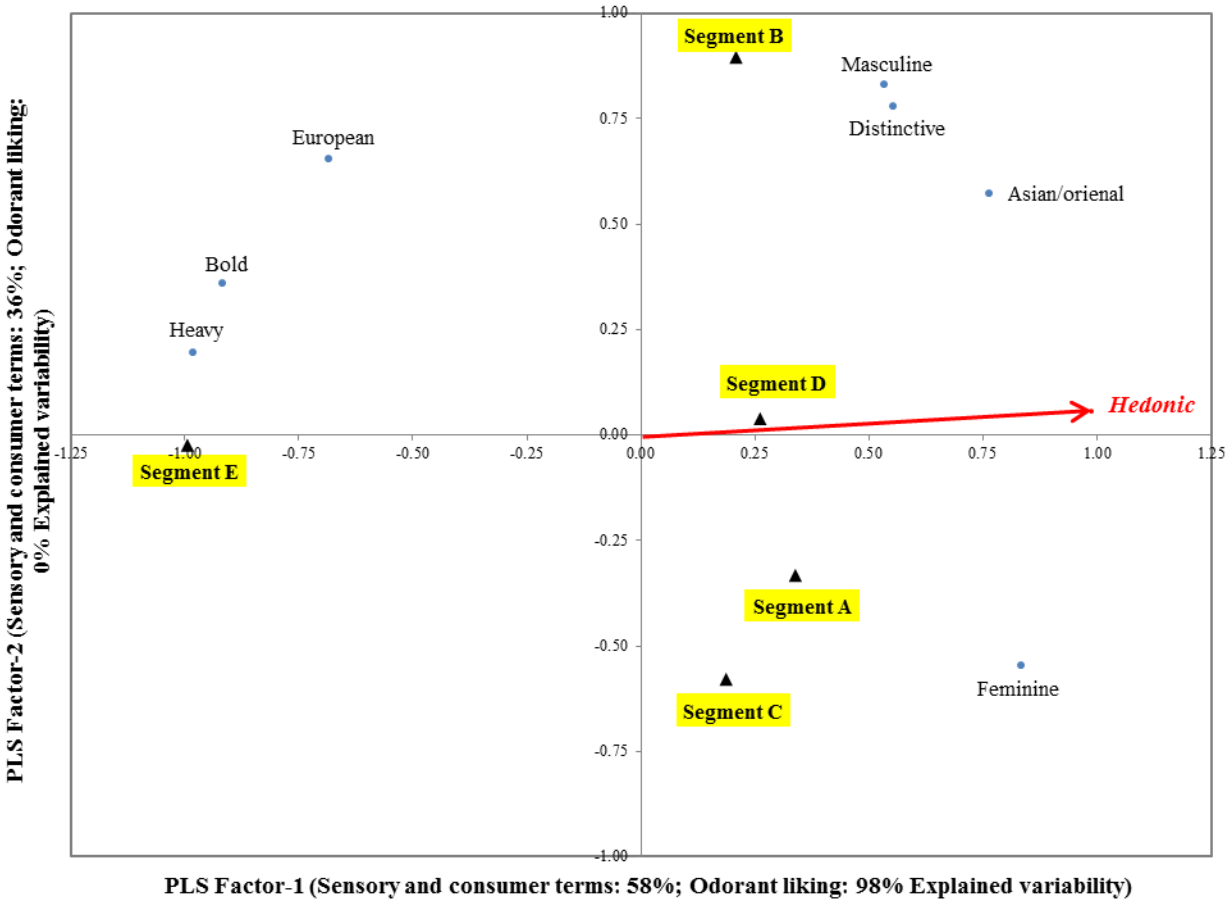
Supplementary Results for Chapter 9

Supplementary Table 9.1 Average Intensity Rating Scores of Five Odorant Samples on Sensory and Consumer-Related Terms Obtained from Five Consumer Segments

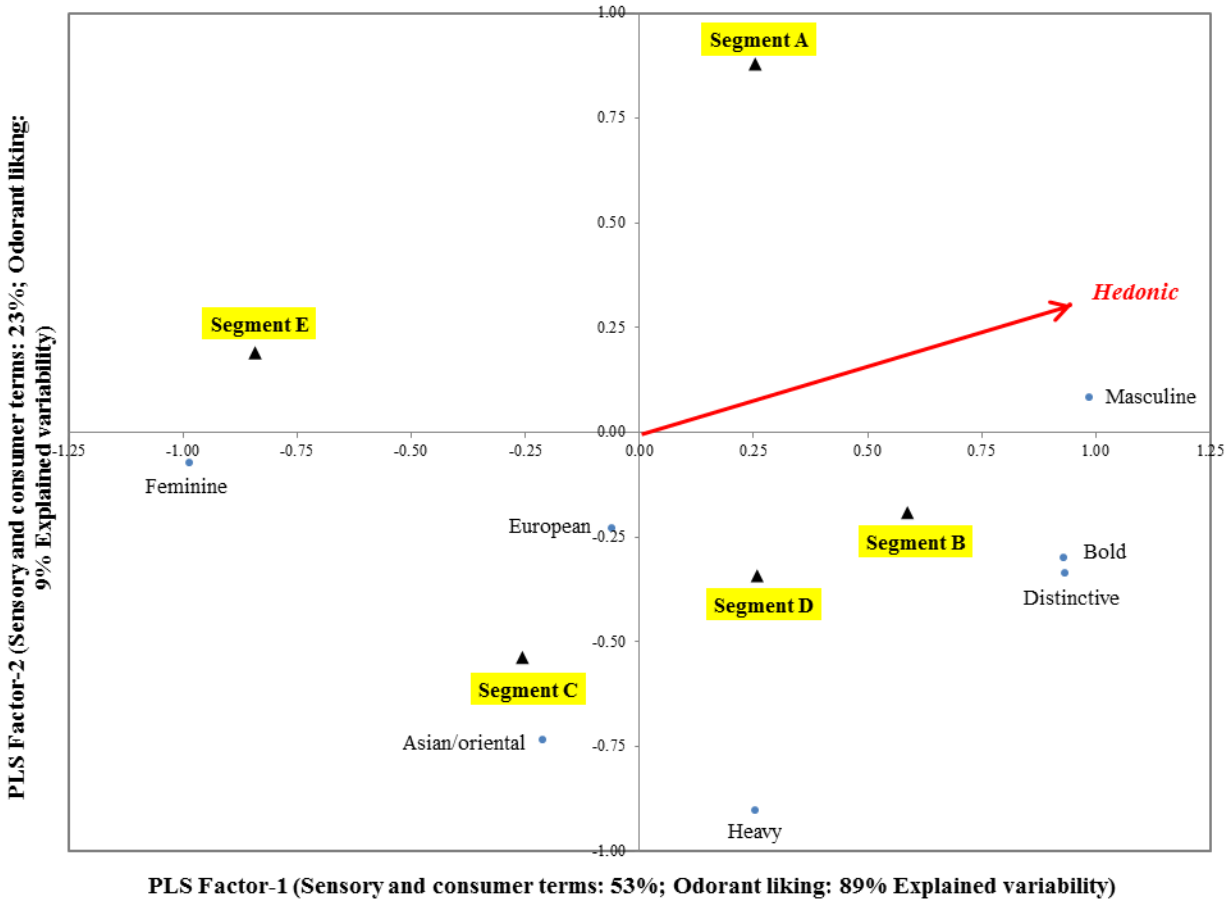
Sensory and consumer-related terms	Consumer segment					p-value		
	A	B	C	D	E	Sample	Segment	Interaction
Bold	3.31 [a]	**3.35 [a]**	3.22 [a]	3.31 [a]	*3.18 [a]*	<0.0001	0.8114	0.0099
Heavy	2.96 [a]	*2.88 [a]*	**3.01 [a]**	2.94 [a]	2.93 [a]	<0.0001	0.8911	<0.0001
Modern	3.12 [b]	**3.41 [a]**	3.15 [ab]	3.09 [b]	*3.00 [b]*	0.0449	0.0074	<0.0001
Clean	3.31 [b]	**3.85 [a]**	3.50 [b]	3.34 [b]	*3.28 [b]*	0.0005	<0.0001	<0.0001
Cool	3.03 [b]	**3.48 [a]**	3.13 [b]	2.87 [b]	*2.79 [b]*	0.0005	<0.0001	<0.0001
Crisp	3.14 [b]	**3.47 [a]**	3.21 [ab]	2.97 [b]	*2.94 [b]*	0.0051	0.0001	<0.0001
Fresh	3.29 [b]	**3.74 [a]**	3.36 [b]	3.23 [b]	*3.06 [b]*	<0.0001	<0.0001	<0.0001
Harmony	2.83 [b]	**3.30 [a]**	2.62 [b]	2.77 [b]	*2.51 [b]*	0.0007	<0.0001	<0.0001
Familiarity	2.98 [b]	**3.38 [a]**	2.94 [b]	3.00 [b]	*2.73 [b]*	0.0251	0.0002	<0.0001
Natural	2.85 [b]	**3.20 [a]**	2.65 [bc]	2.86 [b]	*2.48 [c]*	0.0043	<0.0001	<0.0001
Pleasing the opposite sex	3.20 [b]	**3.73 [a]**	3.24 [b]	3.11 [b]	*2.66 [c]*	0.0846	<0.0001	<0.0001
Distinctive	3.27 [b]	**3.59 [a]**	3.17 [b]	3.41 [ab]	*3.14 [b]*	0.1617	0.0025	0.0004
European	2.76 [a]	**2.96 [a]**	2.89 [a]	2.73 [a]	*2.62 [a]*	0.0239	0.1785	0.0482
Asian/Oriental	1.78 [b]	**2.12 [a]**	1.94	1.99 [ab]	*1.76 [b]*	0.0829	0.0431	0.7179
Masculine	3.40 [b]	**3.78 [a]**	3.40 [b]	3.45 [b]	*3.28 [b]*	<0.0001	0.0031	<0.0001
Feminine	1.96 [a]	2.03 [a]	**2.17 [a]**	*2.09 [a]*	2.13 [a]	<0.0001	0.7464	0.0015

* The agreement on possible applications for personal care products was evaluated using a 5-point scale where 1 = strongly disagree, and 5 = strongly agree. Least square means with the same letter within each row are not significantly different at $\alpha = 0.05$ as determined by multiple t-tests for least significant difference (LSD) mean separation test.

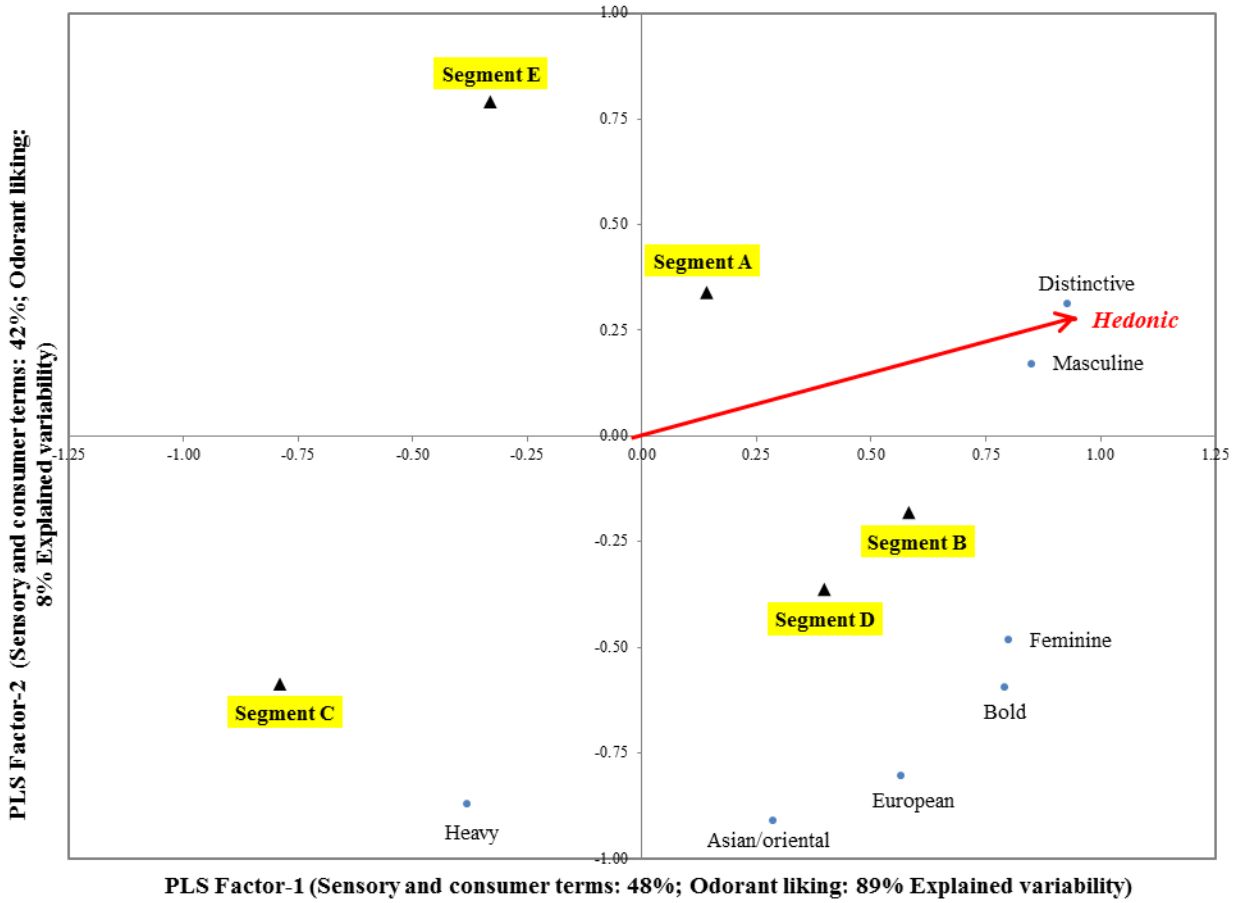
** The numbers listed as **Bold** were the highest ratings where the number listed as *Italic* and underlined were the minimum value across the five consumer segments.



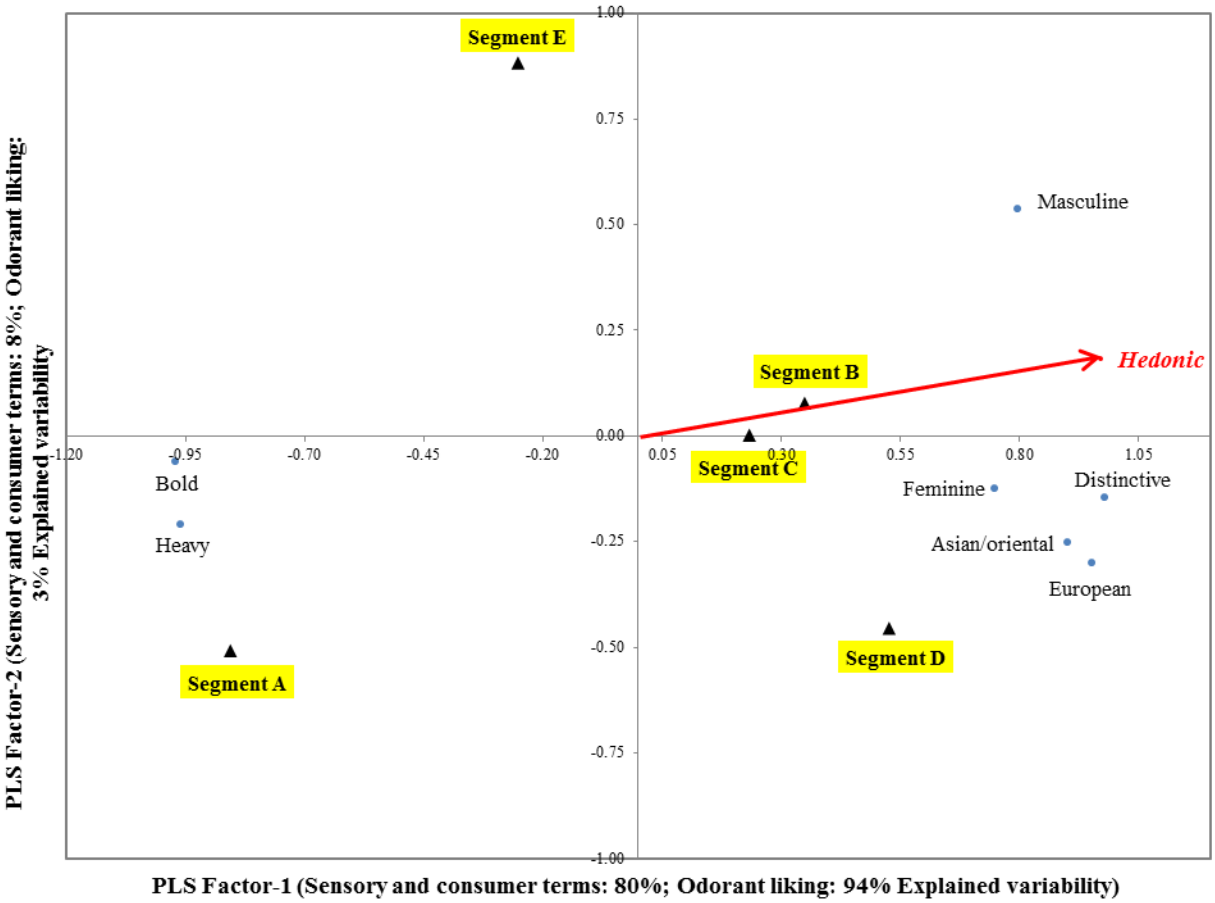
Supplementary Figure 9.1 **Partial Least Square map obtained by PLS-1 analysis of selected sensory and consumer-related terms (X-variables) and odorant liking data of five consumer segments on odorant sample 112 (Y-variables) (X =58% and 36%, Y = 98% and 0%)**



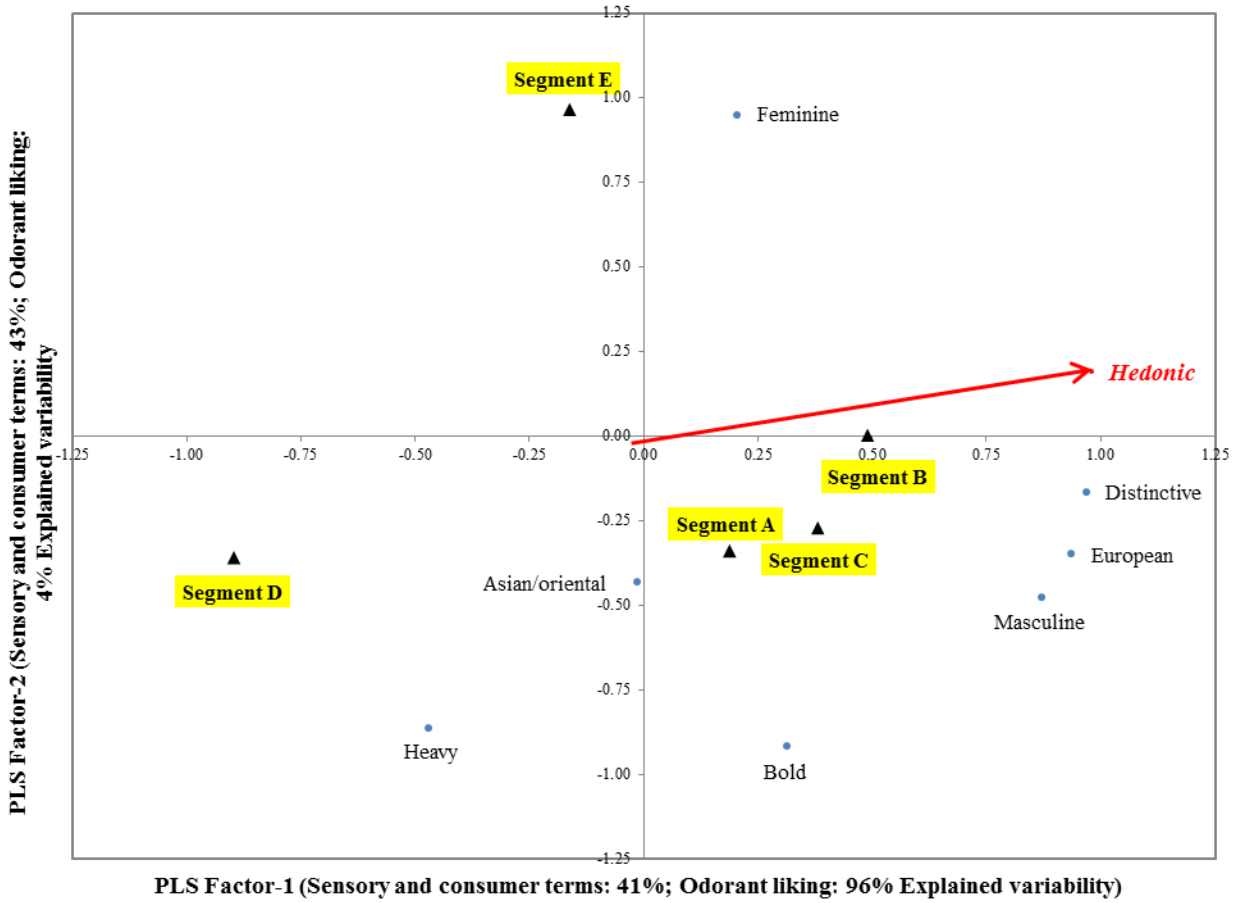
Supplementary Figure 9.2 **Partial Least Square map obtained by PLS-1 analysis of selected sensory and consumer-related terms (X-variables) and odorant liking data of five consumer segments on odorant sample 357 (Y-variables) (X =53% and 23%, Y = 89% and 9%)**



Supplementary Figure 9.3 **Partial Least Square map obtained by PLS-1 analysis of selected sensory and consumer-related terms (X-variables) and odorant liking data of five consumer segments on odorant sample 413 (Y-variables) (X =48% and 42%, Y = 89% and 8%)**



Supplementary Figure 9.4 **Partial Least Square map obtained by PLS-1 analysis of selected sensory and consumer-related terms (X-variables) and odorant liking data of five consumer segments on odorant sample 504 (Y-variables) (X =80% and 8%, Y = 94% and 3%)**



Supplementary Figure 9.5 **Partial Least Square map obtained by PLS-1 analysis of selected sensory and consumer-related terms (X-variables) and odorant liking data of five consumer segments on odorant sample 958 (Y-variables) (X =41% and 43%, Y = 96% and 4%)**

Chapter 10 - Prediction of Fragrance Acceptance Patterns Based on Demographic and Personality Characteristics

Abstract

Personal factors (i.e., demographic information and personality traits) are used to classify consumers into specific groups to investigate acceptance or preference for products by each segment. Such information may assist product developers and marketers to selecting the right fragrance for a target market. Thus, this study's objectives were to (1) investigate the fragrance acceptance trends of consumers from different segments, (2) investigate effectiveness of consumer segmentation criteria for understanding acceptance of fragrance, and (3) indicate a preference trend for specific consumer segments.

A Home-Use-Test was conducted having 240 consumers across the United States (US) to evaluate and indicate their acceptance toward five masculine odorant samples representing different olfactory characteristics. The results demonstrated that application of both demographic and personality information for understanding consumer liking generally provided insufficient explanation for fragrance liking. However, results indicated that people who are more open had a higher tendency for liking all the odorants than other consumers. Specific fragrance preference trends for specific consumer segments also were found (e.g., younger consumers tended to like *soft floral-powdery* scents, and people who were more agreeable tended to like *oriental-floral* notes.

Introduction

Manufacturers incorporate fragrances in various types of products (personal care, household care, air-care, and luxury items) (Wolfe & Busch, 1991; Milotic, 2003). In addition, merchandisers also use fragrance for representing services (spa, hotels, and retailers) (Anonymous, 2007; Gleason-Allured, 2008; Tanner, 2008).

Major strategic sensory marketing now uses fragrance as a reinforcement and support for marketing elements (brand, product, packaging, advertising message, etc.) (Gleason-Allured & Grabenhofer, 2010; Falk & Penning, 2012; Porcherot et al., 2012), making it a part of consumer acceptance and purchase intent (Schroiff, 1991; Milotic, 2003; Gleason-Allured, 2008; Tanner, 2008; Gleason-Allured & Grabenhofer, 2010; Grubow & Kastner, 2011).

Fragrance appreciation primarily impacts the initial purchase decision for fragrance and personal care products (Schroiff, 1991; Gleason-Allured, 2008; Hayden, 2008; Grubow & Kastner, 2011). Products containing a 'good' fragrance tend to be successful as scents directly lead to repeat usage and brand loyalty (Gleason-Allured & Grabenhofer, 2010; Penning, 2011; Falk & Penning, 2012).

Researchers primarily use personal factors, such as demographics characteristics (age and gender) and psychological factors (e.g., personality traits, emotions), for classifying consumers into specific populations to aid in understanding preference and acceptance of each consumer population (Wedel & Kamakura, 1998; Rétiveau, 2004; Eertmans, Victoir, Vansant, & Bergh, 2005; Honkanen, Olsen, & Myrland, 2006; Frank, Lubetkin, & Melnikow, 2007; Rentfrow, Goldberg, & Zilca, 2011). FitzGerald and Arnott (1996) and Honkanen et al. (2006) suggested that consumer classification using age and gender tended to provide results that were easy to understand and interpret. However, Honkanen et al. (2006) also indicated that for the study of purchase behavior and preference, segmentation using age and gender provided insufficient

explanation, whereas personality segmentation provided better explanation for these particular studies.

Previous studies indicated that age, gender, and personality traits influence motivations for fragrance usage, consumer preference, and acceptance (Bain, 1997; Graham, 2000; Rétiveau, 2004). However, no study specified or compared the effectiveness of demographic and personality information for predicting fragrance acceptance. Additionally, findings related to consumer fragrance preference from a specific population could help product developers and marketers select appropriate fragrances for a target market. Therefore, this study's objectives were to (1) investigate the fragrance acceptance trends of consumers from different segments, (2) investigate effectiveness of consumer segmentation criteria for understanding acceptance, and (3) indicate a preference trend for specific consumer segments.

Materials and Methods

Respondents

A total of 300 participants were selected from 976 male and female participants across the US who completed the Big-five inventory personality survey (Benet-Martínez & John, 1998). The male participants used cologne, fragrance, or fragranced personal care products, and the female participants liked the smell of cologne, fragrance, or personal care products on men or find themselves attracted to a person who uses these products.

Respondents were divided into subcategories based on demographic information (gender and age [18-25, 26-35, and 36-49]). Fifty participants from each sub-demographic (2 genders x 3 age groups) were randomly selected to participate in this study. However, only 240 consumers completed the survey and provided all responses.

Odorant Selection

Only masculine odorant samples were used in this study in order to reduce the variability in the fragrance category of gender association. For this study, researchers selected four representative odorant samples from a pool of odorants used in personal care products and commercially available cologne. The samples contained distinctive olfactory characteristics from each other. Additionally, each sample had diverse characteristics that covered at least 2-3 subfamilies in Edwards' fragrance wheel (Edwards, 2008) (Table 10.1).

Table 10.1 Selected Odorant Samples and their Class and Description

Odorant type	Sample	Edwards' classification	Description
Odorant purposely made for personal care product	112	Mossy woods - Citrus	Chypré: moss, citrus, floral, woody
	357	Soft floral-Powdery- Green	Soapy, vanilla, musk, rose
	413	Floral-Citrus	Lime, violet
	958	Oriental-Floral	Lavender, coconut, anise, musk
Commercial cologne	504	Aromatic	Fougère: geranium, cedar, lime, musk

Sample Preparation

Throughout the study all odorant bottles were stored at room temperature. A 0.5 mL sample of each odorant was transferred on a cut-in-half cotton swab (Qtips®, Uniliver, USA). The scented cotton swab then was placed with the swab side down in an amber vial covered with a screw top cap (Fisher Scientific Inc., PA) and labeled with a 3-digit code.

All samples were packed individually in a clear plastic bubble bag (Staple®, USA) to protect from damage. A label having a letter "A" was placed onto a bag to represent the first sample for evaluation. The other labels (B, C, D, and E), which represented evaluation order from 2^{nd} to 5^{th}, respectively were placed on samples by the assigned presentation order based on

the William-modified Latin square design (Meilgaard, Civile, & Carr, 2007). All five samples were packed in a postage box and sent out to participants using the United States Postal Office (USPS). The sample sets were assumed to arrive at their destinations within 1-3 business days.

Researchers conducted the test when the average temperature across country was at the range of 42-56 °F (National Oceanic and Atmospheric Administration [NCDC], 2012). This information provided assurance that the fragrance samples did not deteriorate during transport.

Internet Survey

Once the odorant samples were delivered, participants were asked to evaluate each sample within a set 3 day periods at their home. The online-survey for each sample was available only on the specified dates. During the set evaluation period for that fragrance, respondents were asked to log in to the website and enter the sample code appearing on the label of the sample vial to access the survey and indicate the odorant acceptance of a specified odorant.

Odorant Acceptance

Participants were asked to indicate how much they liked or disliked the smell of each odorant sample on a 9-point hedonic scale, where 1 represented dislike extremely to 9 represented like extremely.

Data analysis

Data Preparation

The 9-point hedonic scores were transformed by whether the scores fell within the range of dislike extremely to neither like or dislike (1-5 points), or the range of like slightly to like extremely (6-9 points). The transformed values were 0 (if the hedonic score was lower than 6)

and 1 (if the hedonic score was equal or higher than 6), and the new values represent whether the consumers disliked or liked odorant samples, respectively.

Logistic Regression

Researchers used logistic regression analysis for predicting the binary response (dislike and like) by using demographic and personality information as predictors. The demographic information consisted of two categorical variables, age (18-25, 26-35, and 36-49 years old) and gender. Each computed consumer personality characteristics (e.g., openness of experience, conscientiousness, extraversion, agreeableness, and neuroticism) consisted of 5 points indicating a personality level from low (1) to high (5). The computed characteristics were used because the use of the full 44 variables would have made the analysis cumbersome in this case.

Scientists used a logistic regression analysis (PROC LOGISTIC) in SAS to investigate the effectiveness of an individual demographic and personality segmentation (a single-variable model) for explaining consumer liking and predicting consumer liking based on those segmentation criteria. The parameter estimate, probability ($Pr> \chi^2$), and odds ratio were shown to indicate effectiveness of each segmentation criterion. For these analyses, age 18-25, females, and scores of 1 on personality traits were used as baseline scores for comparing differences versus other ages, gender, or scores respectively.

Results and Discussion

Fragrance Acceptance Trends of Consumers from Different Segments

The overall analysis using all consumers and all five odorant samples demonstrated that consumer segmentation using gender, age, and personality traits to investigate fragrance acceptance trends was ineffective for the total population. The odds ratio estimates for these criteria were close to 1 and were not found to be significant ($p>0.05$), indicating that consumers

from different groups (age or gender) had a similar tendency to like the same odorant samples (Table 10.2).

Table 10.2 Parameter Estimates, Probability, and Odds Ratio Estimates for Predicting Consumer Response (Positive Liking and Negative Liking) of the 5 Odorant Samples

Single variable model	Independent variable	Estimate	Prob > χ^2	Odds ratio estimate
Age (years)	Intercept	1.012	<.0001	-
	18-25 (Reference)	-	-	1.000
	26-35	0.154	0.452	1.167
	36-49	0.164	0.421	1.178
Gender	Intercept	1.222	<.0001	-
	Female (Reference)	-	-	1.000
	Male	-0.148	0.273	0.862
Openness of experience	Intercept	0.188	0.674	-
	Openness	0.255	0.030	1.291
Conscientiousness	Intercept	0.966	0.042	-
	Conscientiousness	0.054	0.699	1.055
Extroversion	Intercept	0.452	0.315	-
	Extroversion	0.203	0.120	1.225
Agreeableness	Intercept	0.742	0.169	-
	Agreeableness	0.126	0.450	1.135
Neuroticism	Intercept	1.028	0.028	-
	Neuroticism	0.037	0.795	1.038

Note: Based on logistic regression analysis, using a full model with seven segmentation criteria. The analysis of maximum likelihood estimates was performed to obtain parameter estimates. Significance of parameter estimates was based on the Wald χ^2 value at $p<0.05$.

Similarly with age and gender, personality traits, except for openness of experience, did not predict overall acceptance of the fragrances. An increase by 1-point in conscientiousness,

extroversion, agreeableness, and neuroticism did not seem to influence how consumers liked or disliked the odorants. The odds ratio estimates remained similar whether a person was higher or lower in the aforementioned personality traits. However, the analysis did demonstrate that consumers who were more open may have a higher tendency to like the odorants ($p = 0.302$), as the odds ratio was 1.29. This odds ratio indicates approximately a 30% higher probability that a consumer would give a more positive liking response with every one-unit increase in their openness to experience score.

Effectiveness of Consumer Demographic and Personality Criteria for Understanding Consumer Acceptance Trends for Specific Consumer Segments

Application of demographic and personality groupings generally were ineffective for the understanding liking of the overall data. Similarly, use of demographic and personality criteria to understand acceptance of a specific fragrances for specific consumer segments also generally were ineffective. However, some potential effects of demographic and personality criteria are discussed in the following sections. However these would need more study to determine their actual impact.

Odorant Characterized by Mossy, Woods, Citrus (Chypré)

The results for odorant sample 112 (characterized as chypré consisting of *moss, woods,* and *citrus*) demonstrated that the odds ratios for consumers age 26-35 and 36-49 were 2.33 ($p = 0.081$) and 1.96 ($p = 0.153$), respectively (Table 10.3). This shows that older consumers were approximately 2 times more likely to like that fragrance than younger consumers (18-25 years old).

The odds ratio between male and female consumers was equal to 1.06, indicating that both have about the same odds for liking this sample. However, previous studies indicated that

women tend to be interested in and appreciated scents more than men (Herz & Cahill, 1997; Herz & Inzlicht, 2002; Herz, 2004). That difference from this study could be explained by the relationship between gender association and the sensory characteristics of the odorant sample 112, as it was characterized as a masculine scent: *fresh* (e.g., *citrus*) and *dry-woody* (e.g., *woods* and *mossy*) (Mensing & Beck, 1988; Rétiveau, 2004).

The analysis demonstrated that consumers who were more open had a higher tendency to like the odorants ($p = 0.179$), as the odds ratio was 1.50. This odds ratio indicates approximately a 50% higher probability that a consumer would give a more positive liking response with every one-unit increase in their openness to experience score. Previous studies demonstrated that perfumes characterized as *chypré* tended to fit well with people who were emotionally stable (less neurotic) (Mensing & Beck, 1988; Rétiveau, 2004). The results of this study indicated that neuroticism did not influence *chypré* acceptance ($p = 0.427$). However, the result still indicated that a 1-point increase in neuroticism suggested that the probability of consumers to like this *chypré* fragrance would decrease 60%, indicating consumers who were less neurotic liked this odorant. In addition, the odds of liking *chypré* smell remained almost the same if extroversion, conscientiousness, and agreeableness increased by 1-point (Table 10.3).

Table 10.3 Parameter Estimates, Probability, and Odds Ratio Estimates for Predicting Consumer Response of Sample 112 (*Chypré: Mossy-Woods-Citrus*)

Single variable model	Independent variable	Estimate	Prob > χ^2	Odds ratio estimate
Age (years)	Intercept	0.981	0.012	-
	18-25 (Reference)	-	-	1.000
	26-35	0.846	0.081	2.330
	36-49	0.675	0.153	1.963
Gender	Intercept	1.581	<.0001	-
	Female (Reference)	-	-	1.000
	Male	0.060	0.863	1.062
Openness of experience	Intercept	0.079	0.945	-
	Openness	0.409	0.179	1.505
Conscientiousness	Intercept	1.466	0.229	-
	Conscientiousness	0.042	0.906	1.043
Extroversion	Intercept	2.757	0.019	-
	Extroversion	-0.330	0.321	0.719
Agreeableness	Intercept	2.340	0.077	-
	Agreeableness	-0.226	0.576	0.797
Neuroticism	Intercept	2.536	0.032	-
	Neuroticism	-0.286	0.427	0.751

Note: Based on logistic regression analysis, using a full model with seven segmentation criteria. The analysis of maximum likelihood estimates was performed to obtain parameter estimates. Significance of parameter estimates was based on the Wald χ^2 value at $p<0.05$.

Odorant Characterized by Soft Floral, Powdery, Green

Strong trends indicated specific consumer groups liked odorant 357, characterized as *soft floral-powdery-green*. The probability of female consumers liking this odorant sample was roughly 1.4 times higher than male consumers (odds ratio for male consumers was 0.70 compared to females [p = 0.2513]) (Table 10.4). A powdery note can provide a perception of feminine rather than masculine (Anonymous, 2010) and this data confirms that idea.

The analysis also suggests that younger consumers are almost twice as likely to like this powdery scent compared to 26-49 year olds (p = 0.2971 and 0.2749, respectively). Apparel brands (e.g., Hollister, Abercrombie & Fitch, and Victoria's Secret) that have ventured into the perfume market target *powdery* scents to the youth market (Fragrantica, 2013a-c). Because of this market schematic, the apparel industry has exposed and familiarized younger consumers with this type of smell.

The analysis result also indicated that the odds ratio estimates of openness to experience and neuroticism for consumers to like the *powdery* odorant were 1.62 (p = 0.0544) and 1.41 (p = 0.2411), respectively. These odds indicated that the probability of consumers liking odorant 357 were 60% and 40% higher with every one-unit increase of openness to experience and neuroticism. In other words, if the consumers were open to experience or are more neurotic, their chances became higher for liking the powdery *odorant*. Mensing and Beck (1988) and Rétiveau (2004) reported fragrances characterized by *floral-aldehyde* and *powdery* tended to fit well with emotionally unstable persons, therefore supporting this study's findings. Meanwhile, the difference in conscientiousness, extroversion, and agreeableness dimensions did not seem to affect the probability of consumers to like this type of *powdery* odorant as the odds ratios were close to 1 (Table 10.4).

Table 10.4 Parameter Estimates, Probability, and Odds Ratio Estimates for Predicting Consumer Response of Sample 357 (*Soft Floral-Powdery-Green*)

Single variable model	Independent variable	Estimate	Prob > χ^2	Odds ratio estimate
Age (years)	Intercept	1.312	0.002	-
	18-25 (Reference)	-	-	1.000
	26-35	-0.498	0.297	0.608
	36-49	-0.518	0.275	0.596
Gender	Intercept	1.045	<.0001	-
	Female (Reference)	-	-	1.000
	Male	-0.352	0.215	0.703
Openness of experience	Intercept	-0.942	0.318	-
	Openness	0.482	0.054	1.619
Conscientiousness	Intercept	0.228	0.820	-
	Conscientiousness	0.190	0.519	1.209
Extroversion	Intercept	0.119	0.899	-
	Extroversion	0.218	0.425	1.243
Agreeableness	Intercept	1.099	0.320	-
	Agreeableness	-0.072	0.832	0.930
Neuroticism	Intercept	-0.222	0.823	-
	Neuroticism	0.340	0.271	1.405

Note: Based on logistic regression analysis, using a full model with seven segmentation criteria. The analysis of maximum likelihood estimates was performed to obtain parameter estimates. Significance of parameter estimates was based on the Wald χ^2 value at $p<0.05$.

Odorant Characterized by Floral-Citrus

The notes *floral* and *citrus* mainly characterized one of the masculine odorants (sample 413) used in this study. It is commonly known that *floral* scents are well accepted and primarily made for women, whereas, *citrus* scents (*fresh* scents) are generally liked and made for men (Rétiveau, 2004; Zarzo, 2007; Gilbert, 2008; Donna, 2009). Based on these connections,

researchers hypothesized that this odorant, characterized by both *floral* and *citrus,* should have similar high liking by both genders. Data suggest that is was similar, though not exactly the same.

Mensing and Beck (1988) and Rétiveau (2004) stated that the presence of energizing, fresh, and noticeable smells (e.g., citrus) generally were liked by extroverted consumers. Because *citrus* mainly characterizes sample 413, the result demonstrated that the probability for consumers to like this odorant would increase 70% if they were more extrovert (in every 1-unit increase on the 5-point Likert scale). Meanwhile, the likelihood for consumers possessing different levels of openness, conscientiousness, agreeableness, and neuroticism to like this odorant sample indicated no difference (the odds ratios were close to 1.00).

Odorant Characterized by Geranium, Cedar, Musk, Lime (Aromatic Fougère)

The probability of consumers liking odorant 504 was found to be the same across all age groups. Odds ratios for older consumers to like odorant 504 compared to the younger consumers were close to 1 (Table 10.6). Similarly, analyses for this odorant also demonstrated that men had a similar tendency to like this odorant comparing to women. The odds ratio estimate between male and female consumers was 1.01 ($p = 0.9775$). However, previous studies indicated that men tended to like this odorant because it was characterized by *aromatic fougère*, generally liked by men (Rétiveau, 2004; Gilbert, 2008; Donna, 2009; Zarzo, 2007).

An increase 1-level of openness, conscientiousness, agreeableness, and neuroticism did not seem to increase probability for consumers to like this odorant sample (the odds ratios were close to 1.0) (Table 10.6). However, the probability of consumers to like this odorant increased approximately 40% if consumers were more extrovert ($p = 0.2362$) (in every 1-unit increase on a 5-point Likert scale). Rétiveau (2004) also found the relationship between extroversion and

fougère smell and indicated that the extrovert persons tended to like perfumes characterized by *fougère*.

Table 10.5 Parameter Estimates, Probability, and Odds Ratio Estimates for Predicting Consumer Response of Sample 413 (*Floral-Citrus*)

Single variable model	Independent variable	Estimate	Prob > χ^2	Odds ratio estimate
Age (years)	Intercept	1.504	0.001	-
	18-25 (Reference)	-	-	1.000
	26-35	-0.283	0.579	0.754
	36-49	0.464	0.391	1.590
Gender	Intercept	1.700	<.0001	-
	Female (Reference)	-	-	1.000
	Male	-0.292	0.392	0.747
Openness of experience	Intercept	1.526	0.175	-
	Openness	0.006	0.982	1.007
Conscientiousness	Intercept	1.093	0.363	-
	Conscientiousness	0.136	0.701	1.145
Extroversion	Intercept	-0.258	0.821	-
	Extroversion	0.531	0.113	1.701
Agreeableness	Intercept	1.496	0.265	-
	Agreeableness	0.017	0.967	1.017
Neuroticism	Intercept	1.436	0.222	-
	Neuroticism	0.036	0.921	1.036

Note: Based on logistic regression analysis, using a full model with seven segmentation criteria. The analysis of maximum likelihood estimates was performed to obtain parameter estimates. Significance of parameter estimates was based on the Wald χ^2 value at $p<0.05$.

Table 10.6 Parameter Estimates, Probability, and Odds Ratio Estimates for Predicting Consumer Response of Sample 504 (*Aromatic Fougère: Geranium, Cedar, Musk, Lime*)

Single variable model	Independent variable	Estimate	Prob > χ^2	Odds ratio estimate
Age (years)	Intercept	0.693	0.061	-
	18-25 (Reference)	-	-	1.000
	26-35	0.121	0.777	1.129
	36-49	0.236	0.580	1.267
Gender	Intercept	0.843	<.0001	-
	Female (Reference)	-	-	1.000
	Male	0.008	0.978	1.008
Openness of experience	Intercept	0.465	0.618	-
	Openness	0.101	0.679	1.106
Conscientiousness	Intercept	1.244	0.209	-
	Conscientiousness	-0.117	0.685	0.890
Extroversion	Intercept	-0.261	0.781	-
	Extroversion	0.323	0.236	1.381
Agreeableness	Intercept	0.233	0.837	-
	Agreeableness	0.191	0.585	1.211
Neuroticism	Intercept	1.163	0.231	-
	Neuroticism	-0.098	0.742	0.907

Note: Based on logistic regression analysis using a full model with seven segmentation criteria. The analysis of maximum likelihood estimates was performed to obtain parameter estimates. Significance of parameter estimates was based on the Wald χ^2 value at $p<0.05$.

Odorant Characterized by Oriental-Floral

In contrast to sample 504 (masculine scent), the sample 958 was characterized by *oriental* and *floral* smells and were the characteristics that females generally liked (Rétiveau, 2004; Donna, 2009; Zarzo, 2007). However, analysis result demonstrated that female and male consumers had similar tendency to like this odorant as the odds ratio was 0.89 (p=0.599).

Researchers also conducted analysis on consumers from different age groups and found that middle age consumers were more likely to like this sample, approximately 2 times higher than younger (odds ratio for middle age consumers to like the odorant compared to younger consumers was 1.91) ($p = 0.1461$) and older consumers (older consumers had similar probability to like the odorant when compared to the younger consumers) ($p = 0.7329$).

Previous studies indicated the relationship between *oriental-floral* scents and certain personality traits. More introverted persons tended to like *oriental* scents, whereas, emotionally stable (less neurotic) persons tended to like *floral* scents (Mensing & Beck, 1988; Rétiveau, 2004). However, analysis results from this study demonstrated that individuals who were more agreeable tended to like *oriental*/*floral* scents. The odds of consumers who were agreeable became approximately 2 times higher when possessing one point higher (odds ratio was 1.98 [$p = 0.088$]) (Table 10.7). Previous studies had indicated that persons who were agreeable tended to like *fruity* notes (Mensing & Beck, 1988; Rétiveau, 2004)

Meanwhile, increasing 1-point of openness, conscientiousness, extroversion, and neuroticism did not seem to increase odds for consumers to like this odorant as the odds ratio estimate for ranged between 1.0-1.33.

Table 10.7 Parameter Estimates, Probability, and Odds Ratio Estimates for Predicting Consumer Response of Sample 958 (*Oriental-Floral*)

Single variable model	Independent variable	Estimate	Prob > χ^2	Odds ratio estimate
Age (years)	Intercept	0.693	0.061	-
	18-25 (Reference)	-	-	1.000
	26-35	0.644	0.146	1.905
	36-49	0.145	0.733	1.156
Gender	Intercept	1.088	<.0001	-
	Female (Reference)	-	-	1.000
	Male	-0.154	0.599	0.858
Openness of experience	Intercept	-0.052	0.957	-
	Openness	0.283	0.268	1.327
Conscientiousness	Intercept	0.849	0.409	-
	Conscientiousness	0.048	0.873	1.049
Extroversion	Intercept	0.256	0.793	-
	Extroversion	0.220	0.434	1.246
Agreeableness	Intercept	-1.160	0.362	-
	Agreeableness	0.681	0.089	1.976
Neuroticism	Intercept	0.659	0.515	-
	Neuroticism	0.110	0.726	1.116

Note: Based on logistic regression analysis, using a full model with seven segmentation criteria. The analysis of maximum likelihood estimates was performed to obtain parameter estimates. Significance of parameter estimates was based on the Wald χ^2 value at $p<0.05$. N/A refers to "not applicable"

Conclusion

The application of demographic and personality characteristics for understanding consumer liking toward specific types of odorants were generally found to be ineffective. However, persons who were more open had a tendency to like most fragrances compared persons who were less open. Analysis results indicated some potential trends. The segmentation using demographic information revealed that women and men had similar tendencies to like odorants. In addition, younger consumers had higher tendency to like *soft floral/powdery* scents compared to their older counterparts who were more likely to favor *chypré* smell. On the other hand, segmentation using personality traits demonstrated that persons in the same segment would like similar smells. For example, extrovert consumers demonstrated a higher tendency to like *floral-citrus* and *fougère* smells. Similarly, neurotic persons (emotionally unstable) tended to like *soft floral/powdery* scent. Results obtained from this study would assist product developers in selecting appropriate fragrances for a target market.

References

Anonymous. (2007, October 12). Product specialization in body care. *GCI Magazine*. Retrieved from http://www.perfumerflavorist.com/fragrance/application/personal/10510722.html?page=1

Anonymous. (2010, July 28). Perfume shrine: Defining powdery and dry in fragrance. Retrieved from http://perfumeshrine.blogspot.com/2010/07/defining-powdery-and-dry-in-fragrances.html

Bain, H. (1997). Why people use perfumes. In P. Jellinek (Ed.), *The Psychological Basis of Perfumery* (4th ed., pp. 232-239). London: Blackie Academic and Professional, Chapman and Hall.

Benet-Martínez, V., & John, O.P. (1998). Los cinco grandes across cultures and ethnic groups: Multitrait method analyses of the Big Five in Spanish and English. *Journal of Personality and Social Psychology, 75*, 729-750.

Donna, L. (2009, December). Fragrance perception is everything relative? *Perfumer and Flavorist*, *34,* 26-35.

Edwards, M. (2008). *Fragrances of the World: Parfums du Monde 2008* (24th ed.). Fragrances of the World, Sidney.

Eertmans, A., Victoir, A., Vansant, G., & Bergh, O. V. D. (2005). Food-related personality trait, food choice motives and food intake: Mediator and moderator relationship. *Food Quality and Preference*, *16*(8), 714-726.

Falk, J., & Penning, A. (2012, June). A sensory journey: Fragrance in branding. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/153230175.html?page=2

FitzGerald, M., & Arnott, D. (1996). Understanding demographic effects on marketing communications as services. *International Journal of Service Industry Management*, *7*(3), 31–42.

Fragrantica. (2013a). Abercrombie & Fitch perfumes and colognes. Retrieved from http://www.fragrantica.com/designers/Abercrombie-%26-Fitch.html

Fragrantica. (2013b). Hollister perfumes and colognes. Retrieved from http://www.fragrantica.com/designers/Hollister.html

Fragrantica. (2013c). Victoria`s Secret perfumes and colognes. Retrieved from http://www.fragrantica.com/designers/Victoria%60s-Secret.html

Franks, P., Lubetkin, E. I., & Melnikow, J. (2007). Do personal and societal preferences differ by socio-demographic group? *Health Economics*, *16,* 319–325. doi: 10.1002/hec.1152

Gilbert, A. N. (2008). *What The Nose Knows: The Science of Scent in Everyday Life.* New York: Harper Perennial.

Gleason-Allured, J., & Grabenhofer, R. (2010, May 13). Unilever and fragrance: Emotion and function. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/93719369.html

Gleason-Allured, J. (2008, October). Scentworld 2008 report optimizing consumer experience through fragrance. *Perfumer and Flavorist*. Retrieved from http://www.perfumerflavorist.com/events/coverage/31286474.html

Graham, J. A. (2000). The psychology of fragrance and aromatherapy. In H. Butler (Ed.), *Poucher's Perfumes, Cosmetics and Soaps* (10th ed., pp. 749-767). Boston: Kluwer Academic.

Grubow, L., & Kastner, A. (2011, December). Evolving gender stereotypes drive growth in Asian men's personal care. *GCI Magazine*. Retrieved from http://www.cosmeticsandtoiletries.com/formulating/category/menscare/134765353.html?page=1

Hayden, N. (2008, May). Scent sleuth: Fragrance trends in hair care. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/18459104.html

Herz, R.S. (2004). A comparison of autobiographical memories triggered by olfactory, visual and auditory stimuli. *Chemical Senses, 29,* 217-224.

Herz, R. S., & Cahill, E. D. (1997). Differential use of sensory information in sexual behavior as a function of sex. *Human Nature, 8*, 275–286.

Herz, R. S. & Inzlicht, M. (2002). Sex differences in response to physical and social factors involved in human mate selection: The importance of smell for women. *Evolution and Human Behavior, 23*, 359–364.

Honkanen, P., Olsen, S. O., & Myrland, Ø. (2006). Preference-based segmentation: A study of meal preferences among Norwegian teenagers. *Journal of Consumer Behaviour*, *3,* 235–250. doi: 10.1002/cb.137

Meilgaard, M., Civile, G. V., & Carr, B. T. (2007). *Sensory Evaluation Techniques (4th ed.)*. Florida, USA: CRC Press.

Mensing, J., & Beck, C. (1988) The psychology of fragrance selection. In Van Toller, S., & Dodd, G. H. (Eds.), Perfumery: *The Psychology and Biology of Fragrance* (pp. 185-204). London, Chapman & Hall.

Milotic, D. (2003). The impact of fragrance on consumer choice. *Journal of Consumer Behaviour, 3,* 179–191. doi: 10.1002/cb.131.

National Oceanic and Atmospheric Administration. (2012). *National Climatic Data Center (NCDC): The World's Largest Active Archive of Weather and Climate Data Producing and Supplying Data and Publications for the World*. Retrieved from http://www.ncdc.noaa.gov

Penning, A. (2011, January 19). The sweet smell of your brand's success. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/business/marketing/114217909.html

Porcherot, C., Delplanque, S., Planchais, A., Gaudreau, N., Accolla, R., & Cayeux, I. (2012). Influence of food odorant names on the verbal measurement of emotions. *Food Quality and Preference*, *23,* 125-133. doi: 10.1016/j.foodqual.2011.07.006

Rentfrow, P. J., Goldberg, L. R., & Zilca, R. (2011). Listening, watching, and reading: The structure and correlates of entertainment preferences. *Journal of Personality*, *79,* 223–258. doi: 10.1111/j.1467-6494.2010.00662.x

Rétiveau, A. N. (2004). *Individual differences and the perception of complex scents* (Doctoral dissertation). Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/27/AnnlyseRetiveau2004.pdf?sequence=1

Schroiff, H. W. (1991). All's well that smells well? *Seminar on Fine Fragrances and Fragrances in Consumer Products Using Research and Development and Optimisation*, London, 13–15 November, E.S.O.M.A.R., Amsterdam.

Tanner, S. (2008, September). Materials: The scent of a winner. *GCI Magazine*. Retrieved from http://www.gcimagazine.com/marketstrends/segments/fragrance/27917624.html

Wedel, M., & Kamakura, W. A. (1998). *Market Segmentation: Conceptual and Methodological Foundations*. London, UK: Kluwer Academic Publishers.

Wolfe, O., & Busch, B. (1991). Two cultures meet and create a third: From consumer goods and fine fragrances to new product concepts. *Seminar on Fine Fragrances and Fragrances in*

Consumer Products Using Research and Development and Optimization. London, 13–15 November, E.S.O.M.A.R., Amsterdam.

Zarzo, M. (2007). The sense of smell: Molecular basis of odorant recognition. *Biological Reviews*, *82,* 455–479.

Chapter 11 - Conclusions and Future Research

The studies of effects of men colognes on consumer perceptions revealed differing efficacy of different consumer segmentation approaches. Researchers found results obtained from demographic (age and gender) and personality (Big-Five) segmentation provided insufficient explanation for general fragrance research. Participants from different segments generally experienced the same emotions, had similar olfactory liking toward the same odorant, and similarly provided similar responses (use occasion potential application, and expectation of functional benefits) on an overall basis. However, researchers found that consumer segmentation using a liking response provided better explanation.

Regardless to the similarity among demographic and personality segmentation, there were trends indicating persons who were more open had a higher tendency to like most fragrances compared to persons who were less open. In addition, specific segments had different tendencies to like a specific type of odorant e.g., men were more likely to like *fougère* and *chypré* scents. In addition, younger consumers had a higher tendency to like *soft floral/powdery* smell, extrovert consumers demonstrated a higher tendency to like *floral-citrus* and *fougère* smells. Using both demographic and personality characteristics along with segmenting consumers based on liking yields a broader understanding of fragrance acceptance.

This research found some gender difference. For example, men associated the term *feminine* with odorants more than women, and women associated the term *masculine* with odorants more than men. In addition, researchers also found that consumer acceptance influenced how individuals associated terms toward particular odorants. For example, terms such as *clean*, *cool*, *crisp*, *fresh*, and *natural* were associated with the most liked odorants. In contrast, terms

such as *heavy* and *bold* were highly associated with the least liked samples. This was true regardless of the actual odor classification of the sample that was liked or disliked.

It is apparent that using the developed questionnaire was partly successful in providing information on how specific consumer group responded to specific fragrances. It would be beneficial to use this questionnaire to examine more fragrance types to cover all fragrance families, as well as incorporate unisex and feminine fragrances for better understanding. It is essential in conducting further studies that liking be measured because that was the single most important aspect of the fragrance and affected all other aspects. The information obtained from this study could provide a more complete understanding in fragrance research.

This study evaluated only odorants that generally were well-accepted although not necessarily by each consumer, it would be important to continue this research looking at a wider range of fragrances and potentially including some that were disliked by a larger group of consumers. It is reasonable to further investigate how consumers would respond to similar fragrances (same fragrance family) that vary in complexity or that received different liking scores.

Appendices

Appendix A - Screening Survey

1. Are you or is anyone in your household employed in any of the following industries? Please select all that apply.

Advertising, marketing, public relations or marketing research……...*(Discontinue)*

Manufacturing or retailing of personal care products……...*(Discontinue)*

None of these……*(Continue)*

2. Please indicate your gender

Male……..…… ……..*(Continue to **3A**)*

Female……. ……*(Continue to **3B**)*

3A) *(FOR MEN)* Do you use any cologne, fragrance, or fragranced personal care products (such as deodorants, shave gel/cream, shave balm, body wash etc.)?

Yes…… ……*(Continue)*

No…… …….*(Discontinue)*

3B) *(FOR WOMEN)* Do you like the scent of cologne, fragrance, or personal care products (such as deodorants, shave gel/cream, shave balm, body wash etc.) on Men *OR do you find attractive to a person who used these products*?

Yes…… ……*(Continue)*

No…… …….*(Discontinue)*

These last few questions are for classification purposes only. We don't mean to pry, but we need some information in order to compare your responses with others.

4. Please indicate your age

Under 12 years ……..……*(Discontinue)*

12-17 years ……..*(Discontinue)*

18-25 years …….. *(Continue completing the screener)*

26-35 years …….. *(Continue completing the screener)*

36-49 years …….. *(Continue completing the screener)*

50-59 years …….. *(Discontinue)*

60 years or above…….. *(Discontinue)*

5. What is the highest level of education you have achieved?

Primary education only

High school diploma

College degree

Graduate school (e.g., master's degree, Ph.D., etc.)

6. How would you describe your Ethnicity?

Black/African American

Hispanic/Latino

Native American/ Indian

Asian

White/Caucasian

Native Hawaiian and Pacific Islander

Appendix B - Big-Five Inventory Questionnaire

The following Statements concern your perception about yourself in a variety of situations.

Please indicate the strength of your agreement with each statement: 1 = strong disagreement to 5=strong agreement

There are no “right” or “wrong” answers, so select the number that most closely reflects you on each statement. Take your time and consider each statement carefully.

Statement	Strongly disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly agree
Can be cold and aloof	1	2	3	4	5
Can be moody	1	2	3	4	5
Can be somewhat careless	1	2	3	4	5
Can be tense	1	2	3	4	5
Does a thorough job	1	2	3	4	5
Does things efficiently	1	2	3	4	5
Generates a lot of enthusiasm	1	2	3	4	5
Gets nervous easily	1	2	3	4	5
Has a forgiving nature	1	2	3	4	5
Has an active imagination	1	2	3	4	5
Has an assertive personality	1	2	3	4	5
Has few artistic interests	1	2	3	4	5
Is a reliable worker	1	2	3	4	5
Is considerate and kind to almost everyone	1	2	3	4	5
Is curious about many different things	1	2	3	4	5
Is depressed, blue	1	2	3	4	5
Is easily distracted	1	2	3	4	5
Is emotionally stable, not easily upset	1	2	3	4	5
Is full of energy	1	2	3	4	5
Is generally trusting	1	2	3	4	5
Is helpful and unselfish with others	1	2	3	4	5
Is ingenious, deep thinker	1	2	3	4	5
Is inventive	1	2	3	4	5
Is original, has new ideas	1	2	3	4	5
Is outgoing, sociable	1	2	3	4	5
Is relaxed, handles stress well	1	2	3	4	5
Is reserved	1	2	3	4	5
Is shy, inhibited	1	2	3	4	5
Is sometimes rude to others	1	2	3	4	5

Is sophisticated in art, music, or literature	1	2	3	4	5
Is talkative	1	2	3	4	5
Likes to cooperate with others	1	2	3	4	5
Likes to reflect, play with ideas	1	2	3	4	5
Makes plans, follows through with them	1	2	3	4	5
Perseveres until the task is finished	1	2	3	4	5
Prefers work that is routine	1	2	3	4	5
Remains calm in tense situations	1	2	3	4	5
Starts quarrels with others	1	2	3	4	5
Tends to be disorganized	1	2	3	4	5
Tends to be lazy	1	2	3	4	5
Tends to be quiet	1	2	3	4	5
Tends to find fault in others	1	2	3	4	5
Values artistic, aesthetic experiences	1	2	3	4	5
Worries a lot	1	2	3	4	5

Appendix C - Questionnaire

1. Below you will find words which describe different kinds of moods and feelings.
Using the terms listed, please describe how you ***FEEL RIGHT NOW.*** Please rate each feeling.

Desire, Romantic, In love:

Not intense at all ——————————————— *Extremely intense*

Relaxed, Reassured, Serene:

Not intense at all ——————————————— *Extremely intense*

Well-being, Pleasantly Surprised, Happiness:

Not intense at all ——————————————— *Extremely intense*

Energetic, Invigorated, Clean:

Not intense at all ——————————————— *Extremely intense*

Nostalgic, Mouthwatering, Amusement:

Not intense at all ——————————————— *Extremely intense*

Dirty, Disgusted, Unpleasantly surprised:

Not intense at all ——————————————— *Extremely intense*

2. Please smell the cologne # _____

3. How much do you like the smell of this product?

1	2	3	4	5	6	7	8	9
Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither Like Nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely

4. Below you will find words which describe different kinds of moods and feelings.
Using the terms listed, please describe how you ***FEEL RIGHT NOW.*** Please rate each feeling.

Desire, Romantic, In love:

Not intense at all ——————————————— *Extremely intense*

Relaxed, Reassured, Serene:

Not intense at all ——————————————— *Extremely intense*

Well-being, Pleasantly Surprised, Happiness:

Not intense at all ——————————————— *Extremely intense*

Energetic, Invigorated, Clean:

Not intense at all ——————————————— *Extremely intense*

Nostalgic, Mouthwatering, Amusement:

Not intense at all ——————————————— *Extremely intense*

Dirty, Disgusted, Unpleasantly surprised:

Not intense at all ——————————————— *Extremely intense*

5. If you are going to wear this cologne, when would you wear it?

I would wear this cologne/fragrance ….	*Strongly Disagree*	*Disagree*	*Neither Disagree nor Agree*	*Agree*	*Strongly agree*
during the day					
during the night					
any time of the day					
in Spring					
in Summer					
in Fall					
in Winter					
when I play sports					
when I am having outdoor activities (hiking, traveling, kayaking, etc.)					
in Formal occasion					
in Casual occasion					

6. Do you think this scent is suitable to be found in … ?

	Strongly Disagree	*Disagree*	*Neither Disagree nor Agree*	*Agree*	*Strongly agree*
All in one (Face/Hair/Body/Shave)					
Astringent /Toner					
Body Wash, Soaps, Gel					
Body Lotions					
Facial Cleansers					
Facial Cream/Shave balm					
Shave Gel/Cream/Foam					
Sun Screen					
Shampoo/Conditioner					
Hair Styling					

7. If this scent was found in personal care products, you would expect them to provide you … ?

	Strongly Disagree	*Disagree*	*Neither Disagree nor Agree*	*Agree*	*Strongly agree*
Hydrate					
Moisturizing					
Recharge/Energized					
Refreshing/ Invigorating					
Gentle Clean					
Deep Clean/Ultimate Clean					
Clean					
Smooth					
Soften					
Soothing					
Restoring/ Recovery /Repairing/ Healing/Replenish					
Revitalizing					
Cooling					
Heating					
Odor Protection					
Sensitive skin					
Clear skin					

8. What do you think about the characteristics of the cologne you just smell?

Characteristics	Level of characteristics						
Bold	*(Not at all)*	1	2	3	4	5	*(Very much)*
Heavy	*(Not at all)*	1	2	3	4	5	*(Very much)*
Modern	*(Not at all)*	1	2	3	4	5	*(Very much)*
Clean	*(Not at all)*	1	2	3	4	5	*(Very much)*
Cool	*(Not at all)*	1	2	3	4	5	*(Very much)*
Crisp	*(Not at all)*	1	2	3	4	5	*(Very much)*
Fresh	*(Not at all)*	1	2	3	4	5	*(Very much)*
Harmony	*(Not at all)*	1	2	3	4	5	*(Very much)*
Familiar	*(Not at all)*	1	2	3	4	5	*(Very much)*
European	*(Not at all)*	1	2	3	4	5	*(Very much)*
Oriental-Asian	*(Not at all)*	1	2	3	4	5	*(Very much)*
Masculine	*(Not at all)*	1	2	3	4	5	*(Very much)*
Feminine	*(Not at all)*	1	2	3	4	5	*(Very much)*

Appendix D - Demographic Make-up

Appendix Table D Demographic make-up of 240 consumers who completed fragrance evaluation

Gender	Age		Education	
	Years	Consumers	Level	Consumers
Female (123 consumers)	18-25	12	High school	8
			College	3
			Graduate level	1
	26-35	49	High school	13
			College	30
			Graduate level	6
	36-49	62	High school	25
			College	29
			Graduate level	8
Male (117 consumers)	18-25	21	High school	8
			College	12
			Graduate level	1
	26-35	52	High school	10
			College	34
			Graduate level	8
	36-49	44	High school	15
			College	23
			Graduate level	6