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Modeling Relationships Among Affective Measures of Food Choice: Acceptance, Emotions And Satisfaction

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MODELING RELATIONSHIPS AMONG AFFECTIVE MEASURES OF FOOD CHOICE: ACCEPTANCE, EMOTIONS AND SATISFACTION

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To my beloved parents, Paul and Justine Wordui

&

My dearest family, Clayshavika, Meredith and Corinne

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ABSTRACT

The importance of ascertaining holistic product and consumer understanding beyond liking in the product development process cannot be overstated. This research investigated the role of attribute performance on satisfaction in explaining the relationship between food-evoked emotions and sensory preferences, and examined factors influencing the sensory-emotion profile of food products. In the first phase of this research, a series of consumer studies were conducted using eggs as a test product. First, the extent to which critical product attributes contribute to the satisfaction of quality requirements and purchase intent was determined using Kano modeling concepts. The emotional profile of the product was then examined in attribute presence and absence conditions to evaluate impact of egg quality types. Subsequently, the data were analyzed to elucidate relationships between emotions, satisfaction performance measures and product acceptability. For the expansive aspects of intrinsic, extrinsic, aesthetic, expedient and wholesome characteristics influencing purchase decision of eggs, 8 elements were identified as must-be, 1 attractive, 1 one-dimensional, and 10 indifferent Kano attributes. Attribute absence rather than presence evoked greater consumer discriminating emotions, and emotions and acceptability were more correlated for attribute absence than presence. Emotion and attribute satisfaction performance scores were better predictors of liking in combination than alone. However, emotions in attribute absence outperformed that in its presence, reflecting impact of deeper emotional conceptualizations in attribute absence being a better predictor of liking. Associations were found between Kano attributes and positive emotions. Attractive Kano-related attributes were distinctly drivers of liking, separate from both positive and negative emotions. No evidence of moderating effects of satisfaction performance of expedient egg attributes on the relationship between emotions and liking was found. In the second phase of this research, the

relative effects of color and labeling cues on sensory perception, emotional responses and the sensory-emotion space were evaluated using sweeteners as a food model. Results demonstrated additive effects of color and labeling cues on flavor perception and emotions, contrary to significant interactions on their sensory-emotion profile. Identified associations between attribute performance on consumer satisfaction, emotions and acceptability in this research offer new insights on food-evoked emotions in product development.

CHAPTER 1.
INTRODUCTION

1.1 Background

Sensory evaluation according to the Institute of Food Technologists (1975) is a scientific discipline used to evoke, measure, analyze and interpret reactions to those characteristics of food and materials as they are perceived by the senses of sight, smell, taste, touch and hearing. Sensory tests are classified as either analytical or affective based on their purpose and their use in product research and development, analysis of competitive products, quality control and marketing research and have been invaluable to the food industry over the decades (Lawless and Heymann 1998).

The definition of sensory testing of food and drink in itself implies only a physical experience that involves smell, taste and appearance and thus, determines the subjective bodily state. However, the consumption of food and drinks is not only a corporeal phenomenon with cognitive dimensions, but also and truly, an affective experience. Consumers experience a variety of emotions that can be elicited via interaction with different properties of a product. Successful sensory tests as explained by Larmond (1994) are those whose methods are appropriate to explicitly stated objectives. However, traditional methods of profiling the sensory quality of foods often overlook the emotional state of the assessor as well as emotional reactions during the assessment of the sensory properties of the food product. Nowadays in a highly competitive marketplace, it has often been argued that emotion evoked by products is becoming more and more important for product differentiation, providing differential advantage as many products are now often similar in their characteristics, packaging, and price (Desmet 2002; Jordan 2000; Norman 2004).

Mood and emotion scales have been constructed to measure and evaluate the state of human psychology when experiencing stimuli (Bhumiratana and others 2010). Over the past decade, studies have focused not only on measurement of emotional responses to advertisement and consumer experiences, but also, to product consumption and usage through research in product development and sensory science. Emotion studies related to food have focused on lexicon development, concepts of hedonic asymmetry, emotion scaling, test protocols, elements of questionnaire and the relationship between emotions and liking (Bhumiratana and others 2010; King and others 2010; Laros and Steenkamp 2005). Even though the general role of emotions on consumer behavior has been studied extensively, little is known about how consumers react emotionally to food products and what product aspects (food names, product design, benefit, packaging, pre-conditioning, etc.) trigger emotional reactions.

Success of products in the marketplace warrants that, they fulfill or exceed consumer needs and expectations (Matzler and Hinterhuber 1998). However, different product attributes impact satisfaction differently, hence, prioritization of critical features is vital to the long-term success of any enterprise given limited resources (Kay and Pawitra 2001; Chen 2012). Kano and others (1984) proposed a two-dimensional attribute performance to consumer satisfaction model in contrast to a linear, one-dimensional quality model to help identify key product requirements. The Kano Model has the objective of translating the voice of the consumer into insightful categories of consumer needs (Berger and others 1993) thereby, providing guidance for product development/ improvement in order to achieve enhanced consumer satisfaction and product differentiation from the competitors (Matzler and Hinterhuber 1998; Rivière and others 2006).

1.2 Justification

Food affects the way we feel, and emotions elicited by products may influence consumer attitudes, food choices, and purchase decision. There is a growing interest in evaluating emotions elicited by products in addition to sensory perceptions and preferences, due mainly to the apparent distinctive and discriminative role of emotions in product choice and consumer behavior (Bagozzi and others 1999; Meiselman 2015; Thomson 2007). Knowledge of effects of emotions on food choices and also, of food on emotions can be exploited as a means to differentiate otherwise similar products, thereby offering advantages in today's competitive markets.

An understanding of consumer satisfaction by assessing the dynamics of the benefits hierarchy of product attributes may have significant consequences for optimizing product design to enhance profits. In this regard, the Kano model of attractive quality (Kano and others 1984) effectively partitions product attributes into different dimensions of satisfaction. Since consumer satisfaction can be rationalized as the extent of attribute fulfillment or nonfulfillment in the context of consumer needs and expectations, questions arise as to the predictive aspects of consumer satisfaction and emotions on product acceptability.

Consumer emotional associations to food products can arise from sensory characteristics, anticipated and experienced consequences and other factors external to the product (Desmet and Schifferstein 2008). Although the link between emotions and consumer behavior has been extensively studied in marketing and psychology, understanding what product attributes can elicit positive and negative emotions is only beginning to gain momentum in food research and product development. Emotions may be a greater contributory factor to purchase decision than sensory liking and price and has been utilized for the design of attractive and useful products that

satisfy targeted consumer needs (Jordan 2000; Desmet 2002; Norman 2004; Desmet and Hekkert 2009).

The relationship between food-elicited emotions and acceptability has not been clearly established (King and Meiselman 2010; Gutjar and others 2015). Although both emotion and satisfaction judgments may occur during the product experience, little is known about their correspondence, especially as it pertains to product acceptability. Integration of satisfaction measures may clarify constructs underlying observed associations between emotions and sensory preferences. Therefore, in this research, a first attempt is carried out to evaluate food-evoked emotions in relation to attribute performance on satisfaction as assessed by the Kano Model.

Understanding distinct aspects of the product experience is confounded by many factors intrinsic and extrinsic to the product including sensory properties, packaging cues or brand name. Investigating emotions elicited by a product considering only its sensory characteristics or both its sensory characteristics and packaging/branding can reveal deeper insights relating to product perception and can help companies in the design and optimization of products that exceed consumer expectations. A second aspect of this investigation hence focusses on the effects of extrinsic product cues (packaging labeling and color) separate from the actual taste of a product on consumer perception and emotional responses. A stronger understanding of factors affecting the sensory-emotion profiles of food products will provide invaluable information to product developers.

1.3 Objectives

The overall objective of this research was to investigate the interrelationships between product perception, consumer satisfaction and human emotions. To this end, this research was

divided into two main phases, each with a number of studies designed to address the following specific objectives.

The first phase aimed to explore the relationship between consumer emotions and satisfaction with products utilizing a Kano model approach. Three studies were conducted. The first study examined the extent to which selected product attributes contributed to the satisfaction of consumer quality requirements and purchase intent using the Kano method. In the second study, moderating effects of the presence and absence of specific product quality attributes on the overall emotional profile of the product was assessed and in the third study**,** emotions and satisfaction measures from the first two studies were analyzed for the prediction of hedonic liking. Eggs were utilized as a food model for the first phase of the research owing to their ubiquity, variable product features and familiarity to the consumer.

The second phase of this study examined factors impacting evaluations of the sensory and emotional profiles food products. Specifically, the objective was to evaluate the relative impact of extrinsic product cues (brand, color, packaging, labeling) on consumer emotions and acceptability.

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CHAPTER 2.
LITERATURE REVIEW

2.1 Affective Aspects of Food Preferences

The study of consumer food behavior has historically focused on two classes of deterministic variables - behavioral and attitudinal (Cardello and others 2000). Among behavioral variables are such measures as choice, purchase, and consumption while attitudinal measures commonly comprise the assessment of affective responses such liking/disliking, pleasantness/unpleasantness, satisfaction, or measures of the desire to select or eat foods, e.g. purchase intent or desired frequency of consumption. To guide product development, product improvement, and consumer product understanding in the food industry, evaluations of food preferences and acceptance measures with regard to tasted foods are the adopted standard (Moskowitz 1995; Cardello and others 2000).

It may be unreasonable to expect any set of attitudinal measures to be able to adequately take into account the myriad of variables that define actual consumption situations. Although the prediction of consumer liking/disliking and consumption of foods in real life situations is extremely difficult, Cardello and others (2000) demonstrated a general inadequacy of attitudinal measures to predict actual liking/disliking or consumption of eaten foods, but opined post-test appraisal of satisfaction as a better predictor of consumer behavior toward foods. The measurement of perceived quality in food products is therefore complex with multi-dimensional constructs, and is a relative concept subject to a wide range of situational and contextual factors (Cardello 1995; Jover and others 2004).

Understanding consumer behavior requires a comprehension of cognitive and perceptual processes. Various cognitive perceptions about a product including expectations driven by

factors such as brand image, attitudes, and habits influences sensory perceptions. These processes consequently affect consumer behavior. As food preferences develop for an individual, sensory and cognitive factors may further be influenced by other extrinsic factors, for instance cultural elements moderating relationships between cognition, perception and behavior. Hence, sensory responses are integrated into the memory processing center of the brain, and memories are stronger for events with emotional experiences and emotions can be closely related to sensory attributes and food preferences. In addition to sensory-memory associations, there are both physiological and psychological reasons for food preferences. Physiologically, emotions can emphasize thirst or hunger causing latent associations. Psychologically, tangible food preferences may be formed which help reduce undesirable or enhance desirable emotions. Examples of these direct effects is the preference for crunchy foods (i.e. snacks) when one is angry, bored or frustrated. While soups have also been reported as related to being sad or lonely, wine and gourmet foods have been associated with the emotion love.

2.2 Emotions and the Consumption Experience

There exists a justifiable emergent curiosity about emotions related to the food experience in the sensory and consumer sciences. This has been driven mainly by the intense competition facing new as well as established brands as product homogeneity is now commonplace; and also the growing evidence suggesting that, food-evoked emotions adds a significant dimension to predicting food choices as compared to only liking information (Dalenberg and others 2014; Jiang and others 2014). Assessing the emotional responses due to the various aspects of foods can facilitate emotion-driven product development and marketing that incorporates emotionally active sensory and product attributes to enhance success of products.

Emotions, albeit challenging to define have been described as an instinctive rather than a cognitive mental state that is often accompanied by physiological changes that can be characterized as a feeling. Emotions are therefore multifaceted and contribute many components to our overall perception and behavior (Damasio 2003; Frijda 1986). Feeling good or bad is therefore at the heart of emotion (Ortony and others 1988). Although comparable to moods, emotions have been isolated as being transient as opposed to enduring. Since feelings are either good and/or bad, product design is evidently oriented towards generating good or pleasant feelings. It follows that, products that feel good are purchased, re-purchased, positively appraised establishing a positive brand image, and may be pardoned for design imperfections. Bad or negative feelings, on the contrary, alienates users by breeding complaints, damaging the brand and shrinking sales.

The function of emotions is to safeguard the consumers' relationship with the product and everything that happens with the interaction. In these interactions, various conceptualizations occur that manifests and consolidates the perception of the food (Thomson and others 2010). Our emotional behavior is directed towards adaptation to these occurrences: strengthening associations with attributes that create positive emotions, and weakening relationships with attributes that cause negative emotions. Emotional behavior is therefore driven by conceptualizations directed at experiencing an ideal product (Frijda 1986; Thomson and others 2010).

Emotions shape most of our daily experiences and are deeply linked to physical bodily state. In line with cognitive emotion theory, Damasio (1994) argued that, the human mind operates in sync with the body, with emotions playing a central role in human rationality. The connection between bodily sensations that ensues from interaction with the external environment, emotions

and the surplus value of the emotional evaluation, is particularly interesting in food products. Desmet and Shifferstein (2008) proposed five different sources of food emotions as: sensory properties, experienced consequences (past experience or memories), associated (or anticipated) consequences (for example concern about becoming fat because of eating unhealthy food), personal or cultural meanings and actions of associated agents (for example the gratification that comes from receiving compliments for dishes one has prepared).

Foods and drinks not only activate emotional reactions but also, emotions can provoke and influence food choice and consumption, with some foods considered to be more emotionally laden than others. Macht and Dettmer (2006) studied the emotional changes women experienced after eating a chocolate bar and found that, while joy was elicited by the sensory pleasure of eating chocolate, guilt appeared to be induced by negative thoughts associated with eating chocolate, such as it led to weight gain.

2.2.1 Emotional conditioning

According to Watson and Rayner (1920), emotional conditioning refers to the connection of a previously neutral stimulus (conditioned stimulus) to an emotional reaction (conditioned reaction), by pairing it with a stimulus (unconditioned stimulus) that evokes the target emotion (unconditioned reaction). Classical and evaluative conditioning has been shown to be less effective for familiar stimuli (Cacioppo and others 1992). Shimp and others (1991) suggested that, conditioning new emotions to familiar products should be more difficult than conditioning the same emotions to unfamiliar products due to already existing associations with the familiar products.

Köster (2003) showed that flavor-emotion combinations can be acquired. Emotional conditioning between specific positive emotions (i.e. joy and contentment) and specific drinks have been reported (De Houwer, 2007). Kuenzel and others (2010) further demonstrated that existing associations cannot be easily erased by new conditioning by showing that, positive emotions of joy and contentment could be induced for specific flavors through emotional conditioning especially for novel flavors in the absence of active ingredients. They investigated associations between joy and contentment with specific drinks (moderately/neutrally liked and initially highly liked), while watching film clips evoking either joy, contentment or no emotion in a between subjects design. They found that, the conditioned drinks successfully induced the distinct positive emotions and the emotional associations impacted on the liking of the drink. Liking scores for identical stimuli were also different based on which emotion the drinks were associated with. This was explained as being due to the fact that, while experiencing emotions, attention was divided leading to the liking of the drinks to be scored towards the middle. It is possible that for the unfamiliar flavors, where no associations exist, an opportunity to create a new flavor-emotion combination may exist. A possible caveat however was the possibility that, emotions may not have been transferred to the drinks, but to the location where the experiment was conducted (Kuenzel and others 2010).

2.2.2 Cultural emotions

Social influence on food preferences and consumption have been studied (Addessi and others 2005; Greenhalgh and others 2009), and there are various theoretical grounds that suggests that, children and adults would be sensitive to the emotional expressions of others within the context of eating desire. The facial expressions of others have a powerful influence on

communication and social learning (Niedenthal and others 2006). In humans, facial expressions automatically occur when an emotion is felt (Ekman 1992).

Barthomeuf and others (2011) studied three different emotional expressions depicting three different emotional valence felt towards foods (i.e., positive with pleasure expression, neutrality with neutral expression, and negative with disgusted expression). Results showed that compared with food presented alone, the facial expressions of others influenced the desire to eat liked and disliked foods and in all cases, to a greater extent in younger children compared with adults. Food presented with a pleasant face increased the desire to eat disliked foods, and increased the desire to eat liked foods in only 5-year-old children. Food presented with a neutral face also increased and decreased the desire to eat disliked and liked foods respectively. However with a disgusted face, the desire to eat liked foods decreased, while it had no effect on the desire to eat the disliked foods.

From birth, children show a predisposition for food preferences, such as liking sweet tastes and disliking sour and bitter tastes (Barthomeuf and others 2011). However, they can learn to accept and appreciate a wide variety of foods during childhood. Birch (1980) showed that, after four successive meals, children chose the vegetable that they did not prefer but that the other children preferred. Thus, it seems reasonable to suppose that, within a developmental framework, the influence of adults on children's eating behavior is greater than that of their peers, especially when the latter are their parents (Barthomeuf and others 2011). Klesges and others (1991) clearly illustrated this influence by showing that, children selected fewer foods high in sugar when they were told their mother would inspect their food choice than when their selections were unobserved. Olivera and others (1992) reported that when parents consumed a fatty diet, their children had a greater likelihood to consume such a diet. Since parents dictate food

availability, quantity and preparation, it stands to reason that, at a more subtle level, parents' behavior towards food may affect the eating habits of their children.

The food-related behavior between caregivers and children can be explained to some extent, through the social learning mechanisms transmitted by the former. Adults influence their children through their own behavior towards foods, and children learn by watching and imitation (Barthomeuf and others 2011). In addition, increases in food preferences or intake can be induced by social eating particularly among children (Brown and Ogden 2004; Kristjansdottir and others 2009). In these studies however, either the influence of emotions expressed by other eaters were not controlled or they were realized only under neutral emotional conditioning.

Furthermore, the influence of parental behavior on children's food choices can be found in the theories of embodied cognition that define the role of sensory feedback on experiencing emotion (Barsalou and others 2003). Brain imaging experiments have additionally shown that the mimicry generated by observation of a facial expression activates the mirror neuron system involved in experiencing this emotion, so that the observer experiences the same emotion but to a lesser extent (Barthomeuf and others 2011). In a functional magnetic resonance imaging study, Wicker and others (2003) showed that the observation of disgusted facial expressions automatically activates neural substrates that are normally activated when experiencing the emotion of disgust (i.e., the left anterior insula and the right anterior cingulate cortex). According to the facial feedback hypothesis, facial expression affects the subjective experience of emotions (Barthomeuf and others 2011). However, several versions of the facial feedback hypothesis exist. According to McIntosh (1996), there are multiple and non-mutually exclusive plausible mechanisms for facial effects on emotions. Apparently, an intrinsic link exists between perceiving an emotion in others and feeling this emotion. Nonetheless, children have more

difficulty than adults in controlling and inhibiting spontaneous imitation due to the maturation of the prefrontal cortex that continues until the end of adolescence (Barthomeuf and others 2011).

2.2.3 Product emotions and emotion research in food product development

Three main approaches have been explored to examining product emotions over the last decade. These are a pleasantness approach (Jordan 2000), a process-level approach (Norman, 2004) and an appraisal approach (Desmet 2008). Jordan used a psychological pleasantness-framework to explain various types of product pleasantness, Desmet used cognitive appraisal theory to explain the process of product emotion, and Norman explained product emotion with a neurobiological emotion-framework that distinguishes several levels of information processing. Detailed insight into the sources of positive and negative emotions is extremely valuable for theories on product and consumption emotions. Desmet and Schifferstein (2008) described food experiences as being primarily positive, a concept referred to as hedonic asymmetry, and Porcherot and others (2010) also found mainly positive emotions associated with perfume odors.

In the product development process, often a lot of time, money, and energy are invested in consumer research that aims to understand the concerns that underlie consumers' appraisals and emotions. These understandings are then used to carefully design products to facilitate consumer goal achievement (aspiration based appraisal), to provide pleasure (pleasure-based appraisal), and to meet or exceed expectations (integrity-based appraisal).

Each of the three appraisal types evokes specific and different positive and negative emotions. Aspiration-based appraisals evoke emotions like joy, hope, sadness, and anxiety. Pleasure-based appraisals evoke emotions like amusement, fascination, disgust and boredom. Integrity-based appraisals evoke emotions like admiration, satisfaction, contempt, and

dissatisfaction (Desmet 2010). The specific emotion that is experienced therefore depends on the appraisal and the particular concern involved.

Previous studies have measured food-related emotions that are already established (emotions associated with various food products such as pizza, savory snacks, chocolate, pasta meals), as well as establish new associations between specific positive emotions (i.e. joy and contentment) and specific drinks, using an emotional conditioning paradigm (de Houwer 2007).

2.2.4 Measurement of food-evoked consumer emotions

A number of emotion measurement tools have been developed to assess a wide variety of emotional reactions to the food product experience in consumer testing. These methods can be categorized into 2 main types: explicit and implicit. Explicit methods refer to self-reported verbal and visual measurements, while implicit methods like physiological and facial recognition methods detect and quantify emotions at the biological level. These methods are increasingly being studied in the sensory sciences, and have limitations often traced to the spontaneous nature of emotions which makes measurement a complex task. For product design processes, it is crucial to understand what product features can elicit negative emotions, because this knowledge can help prevent a negative emotional impact of the new design (Desmet and Hekkert 2008). In addition, the verbal measurement of feelings provides insight into consumer liking, thereby improving the discrimination of products that have similar liking scores.

2.2.4.1 Explicit emotion measures

A substantial amount of published research relating to food-evoked emotions involves subjective reports of one's experience. Questionnaire techniques are the most common method to

assess emotional response in which participants are asked to check or rate emotions presented as single terms or questions.

The Differential Emotions Scale (DES) is a validated instrument that reliably divides the individual's description of emotion experience into validated, discrete categories of emotion. The DES was formulated to estimate the emotional state of individuals at that specific point in time when they are responding to the instrument. The DES instructions ask the respondents to consider the experience they described and to rate how often each emotion item was experienced during the experience. The DES consists of a thirty-item adjective checklist, with three adjectives of each of the ten fundamental emotions (joy, surprise, anger, disgust, contempt, shame, guilt, fear, interest, and sadness) proposed by Izard (1993). The DES involves the use of subscales and is backed by extensive research, however, the DES was not developed with product design in mind and may be missing some relevant emotions involved in the product experience. Even though some emotions in the DES would be unrelated to food choices (e.g. inner-directed hostility), the DES requires little adaptation (in terms of its stem or items) and ensures the validity and reliability of the measure. The DES and its prototypes have been consistently shown to have valid, reliable, and internally consistent structures (Izard 1993).

In addition, five items to assess calmness can be included since the experience of calmness (also conceptualized as alleviation of stress, promotion of relaxation etc.) has been reported as a motivation underlying everyday food choice (Steptoe and others 1995). These five items are often generated based on their face validity and subsequent analyses demonstrating their loading on the same underlying factor and that they are internally consistent. Participants are usually asked to rate themselves on the emotion terms after imagining that they had consumed a small

amount of the food item. Questions are answered on a 5-point scale with endpoints ranging from '1' not at all to '5' extremely.

King and Meiselman (2010) developed the EsSense Profile® for measuring short and relatively intense responses about food products and is currently one of the most widely used scales for verbal self-report. The EsSense Profile® provides a detailed list of 39 emotion attributes product category users who typically like the product associate with test products (King and Meiselman 2010). The EsSense Profile® has been used to guide product development efforts similar to those provided by traditional consumer tests as it incorporates both overall acceptability and emotion measures in the consumer test questionnaire. The EsSense Profile® has also been utilized to map a product category and to relate the product to the brand essence, which typically conveys an emotional aspect of the product which is of primary importance to marketing efforts.

The terms in the EsSense Profile® were selected from published literature as well as from consumer input from preliminary studies including central location tests, internet surveys and home use tests. This list of emotions (Table 1) may be expanded or modified to account for emotions that may be appropriate in specific product categories and in specific applications. New terms can be identified from previously collected marketing data or from consumer feedback. Of the selected emotions included in the ballot, classification into positive, negative, and contextual groups of emotions was undertaken by consumers. However, different foods are associated with different emotions, and one comprehensive list might not to be able to cover all food categories. Researchers have used preexisting emotion lists like the EsSense Profile® as a starting block to develop other emotional lexicon (Jiang and others 2014).

Table 2.1 List of emotions used in the EsSense Profile® ballot based on their appropriateness to food.

Active	Glad	Pleased
Adventurous	Good	Polite
Affectionate	Good-natured	Quiet
Aggressive	Guilty	Satisfied
Bored	Happy	Secure
Calm	Interested	Steady
Daring	Joyful	Tame
Disgusted	Loving	Tender
Eager	Merry	Understanding
Energetic	Mild	Warm
Enthusiastic	Nostalgic	Whole
Free	Peaceful	Wild
Friendly	Pleasant	Worried

Source: King and Meiselman 2010

This methodology has been applied to different consumer test approaches, such as central location tests, home use tests and internet surveys, all of which have provided useful data by indicating if any emotions differentiate the test products, and if so, which emotions are stronger or weaker for each particular sample. These data can then be compared to the brand essence or positioning as well as consumer expectations from the product and/or brand.

The EsSense Profile® can accommodate other hedonic and/or diagnostic questions, such as ‘‘just about right” scales, in order to provide a more comprehensive evaluation of the product. As a result, researchers need to be aware of the impact of one measure on other measures, and the order of presentation of each method within a battery of methods needs to be carefully considered. The EsSense method is easy to execute in the lab as it requires minimal changes to a sensory test protocol and is appropriate for internet use and home use tests.

One concern with verbal single-word emotional questionnaires is that participants may be confused by the task (Kenney and Adhikari 2016). Thomson and others (2010) explain that

emotions are irrational impulses and may be distorted when subjected to cognitive thought processes. When Jaeger and others (2013) had participants use the EsSense Profile® and share their thoughts aloud, several participants indicated they did not understand certain emotion words or perceived them to be too similar. Additionally, some participants felt they were not strongly experiencing the emotion words, that the task was long and intimidating, and that they felt pressured by the testing procedure to vary their responses and indicate feelings more strongly (Kenney and Adhikari 2016). Providing extended instructions allowed participants to more quickly get into the task and question it less. While this was not the experience of all participants, one should take into account that there may be a degree of bias in single-word emotion testing (Jaeger and others 2013). One option to address these concerns is to clarify the task by grouping lists of emotions into clusters preceded with the phrase "I feel" (Spinelli and others 2015). Thomson and others (2010) chose to avoid measurement scales altogether by using best-worst scaling for emotional profiling. Consumers are presented with a set of 4-5 emotion words (in quads or quins) to describe the object under investigation. The participants are asked to pick one of the words from 8-20 quads/quins in a balanced statistical design, which was analyzed by predicting the likelihood of them picking a certain word (Thomson and others 2010). These verbal lexicons, in addition to the traditional method of having consumers scale or rate every emotion, can have consumers respond by check-all-that-apply (CATA) or rate-all-that apply (RATA). CATA relieves participants from having to think as much about quantifying their emotions, making the process relatively easier and more natural, but it provides less data to analyze. CATA might be chosen because it is less cumbersome for participants or with children who may have difficulties with a ranking task. Ng and others (2013a) recommend RATA, as it is more sensitive and provides useful quantitative data without the pressure to rank every single

emotion. One other method of response is to rate intensity of emotion clusters on a 150 mm line (Chaya and others 2015). Two additional methods asking panelists to rate a small number of emotions on 10 cm line scales are Visual Analog Mood Scales (VAMS), with eight internal mood states, and GEOS, or Geneva Emotion and Odor Scale, a 6-scale model designed for affective feelings induced by odors (Porcherot and others 2010; Porcherot and others 2015; Kenney and Adhikari 2016).

A relatively new self-report instrument is the EmoSensory® wheel, in which a wheel format questionnaire is used to discriminate emotional and sensory profiles within and between food product categories, and also in both blind and informed conditions (Schouteten and others 2015). Product-specific terms are selected and the rate-all-that-apply (RATA) approach is used for scaling.

Several visual questionnaire techniques have been developed to attempt to avoid the verbal processing required with word scaling measurement instruments. Visual methods measure subjective feelings just like verbal reports, using images to depict different emotional states. Because emotions are intuitive, using images can be useful to ascertain true emotional responses because it limits the rational or cognitive thought process that is required to understand verbal cues (Jaeger and others 2013).

The Self-Assessment Manikin (SAM) was the first visual method developed, with three pictorially-depicted factors – Pleasure, Arousal and Dominance (PAD) which can be rated on a 9-point pictorial scale (Bradley and Lang 1994; Kenney and Adhikari 2016). One of the most well-known visual methods is PrEmo® with seven positive and seven negative emotions depicted as animated cartoon pictures (Desmet and Schifferstein 2008). PrEmo® was not developed as a food product-specific instrument and allows for more negative options, resulting in a larger

spread of valence scores. This made PrEmo® a stronger predictor for product choice than the EsSense Profile® with products such as breakfast drinks, of which there was a considerable amount of dislike (Dalenberg and others 2014). Another visual measurement technique is the Image Measurement of Emotion and Texture (IMET), in which participants were asked to create their own *My Pictures* board, with self-selected images to represent twelve different emotions (Collinsworth and others 2014). Having participants select their own images or providing them with images resulted in less variability in responses than the twelve emotion words alone.

One intriguing new visual instrument is the emotive projection test, in which consumers' rate photographs of people on a number of positive and negative personality traits after consuming a particular food product (Mojet and others 2015) This test reveals subtle differences in the connection between certain food consumption and emotional feelings towards other people (Kenney and Adhikari 2016).

There are several things to take into account when designing a test to measure emotions. While there are hundreds of emotion-related words, the number listed in a questionnaire should be limited to that which can be reasonably scaled by a consumer to avoid panelist fatigue, but also be sufficient to reveal emotional differences among products that might be missed with a smaller number (Jaeger and others 2013; Cardello and others 2012). Most emotion questionnaires have between 30-40 terms and the list of words can be presented in any order, either random or alphabetical (King and Meiselman 2010). However, questions about liking and overall acceptance should be asked before or during emotional scaling, as the experience of thinking about one's emotions has been shown to bias the response if asked after the evaluation (King and others 2013). Additionally, Chaya and others (2015) used a control "dummy" sample as the first sample for every participant to familiarize consumers with the task, subsequently

deleting the dummy-sample data to avoid first-order effects. Selecting a questionnaire depends on the aim of the study and the characteristics of the target group. Many researchers have found it appropriate to make their own emotion lexicon, either by starting from scratch or modifying pre-existing lists such as the EsSense Profile®. Consumer defined lexicons have the benefit of being more discriminating for a particular product than a general lexicon (Ng and others 2013a; Jaeger and others 2013). A consumer-led lexicon costs time and resources but may be able to exclude irrelevant terms and remove consumer confusion (Chaya and others 2015; Kenney and Adhikari 2016).

Lexicon development that begins with previously-generated terms usually goes through a process of determining the relevance and appropriateness of terms with consumer reports and applying criteria with advanced judgment methods (Gmuer and others 2015). Alternatively, emotion words can be generated from scratch. Spinelli and others (2015) had consumers describe emotions felt for groups of 3 liked and 3 disliked chocolate hazelnut spreads, and then used semiotic methodology to identify semantic units, grouping words with the same meaning into the same category. Ng and others (2013b) and Chaya and others (2015) used another term-generation approach with triadic elicitation, asking consumers to describe how two products in a group of three products were emotionally different from the third (Kenney and Adhikari 2016). Lexicons can also be generated from pre-existing language databases. Gmuer and others (2015) looked at comprehensive language databases to extract German emotion terms that were more actively used in everyday situations, thus representing active language use (Kenney and Adhikari 2016).

2.2.4.2 Implicit emotion measures

A number of non-verbal instrumental methods have been utilized to measure either the expressive or physiological response to experienced emotion. Expressive facial, vocal and other bodily reactions to emotions such as smiling, frowning, and contracted eyebrows as well as invisible muscle activity can be measured to capture the emotional response. According to Desmet (2002), facial expression instruments are based on theories connecting expressions to distinct emotions and include the facial action coding system (FACS) and the maximally discriminative facial moving coding system (MAX). Besides, subtle expressions undetectable to the naked eye can be measured since the facial muscle activity of these elusive expressions results in electrical potentials referred to as facial electromyographic activity. Measurement of this activity referred to as facial electromyography (EMG) is determined via the voltage from two electrodes placed on the skin's surface over a particular muscle group (Desmet 2002). For example, pleasant and unpleasant emotions associated with the corrugator muscle and zygomatic facial muscles respectively, can be detected using EMG (Desmet and Schifferstein 2008; Kenney and Adhikari 2016). Similar to the facial expression instruments, vocal instruments are based on theories that link patterns of vocal cues to emotions. These instruments measure the effects of emotion in multiple vocal cues such as average pitch, pitch changes, frequency and intensity, speaking rate, and voice quality.

Furthermore, physiological manifestations such blood pressure responses, skin responses, brain waves, and increases in heart beat may accompany emotions and can be measured with various techniques. Examples of instruments include IBM's emotion mouse, and a variety of wearable sensors designed by the Affective Computing Group at MIT (Desmet 2002). With these instruments, computers gather multiple physiological signals while a person is experiencing an

emotion, learning the most indicative patterns (Desmet 2002). Additionally, electro-dermal activity accompanying emotions can be measured via the skin conductance response (Poels and Dewitte 2006).

Non-verbal instruments have the advantage of being language independent and less subjective, therefore applicable cross-culturally. While physiological methods are reliable and useful, they cannot effectively assess mixed emotions and are limited to a set of basic emotions such as anger, fear, and surprise, providing less detail than self-report measures. Hence, they are less likely to be used to measure food-evoked emotions in a product development context, when the objective is complete characterization of the product using an emotion lexicon (Liao and others 2015; Meiselman 2015; Kenney and Adhikari 2016).

2.3 Definition of Consumer Satisfaction

When talking about food products, consumer satisfaction is a critical element for business success in the current consumer-oriented marketplace (Matzler and Hinterhuber 1998). According to Westbrook and Oliver (1981), consumer satisfaction has been widely defined in the literature, but its conceptualization appears to have received the greatest support in the view that satisfaction is a post-choice evaluative judgment concerning a specific purchase selection (Day 1984).

There are two types of definitions that differ in terms of emphasizing consumer satisfaction either as an outcome resulting from the consumption experience or as a process (Yi 1990). The first definition involves the cognitive state of the buyer being adequately or inadequately rewarded for the sacrifices he has undergone (Howard and Sheth 1969), an emotional response to the experiences provided by or associated with particular products purchased, retail outlets, or

even behavior patterns associated with shopping, as well as the overall marketplace (Westbrook and Reilly 1983); and the second involves a brief psychological state resulting from when the emotion surrounding disconfirmed expectations is coupled with the consumer´s prior feeling about the consumption experience (Oliver 1981).

Notwithstanding, some definitions (Yi 1990) suggest that an evaluative process is an important element underlying consumer satisfaction considering the consumer´s response to the evaluation of the perceived discrepancy between prior expectations and the actual performance of the product as perceived after its consumption, as an evaluation rendered that, the (consumption) experience was at least as good as it was supposed to be (Hunt 1977), and that the chosen alternative is consistent with prior beliefs about that alternative (Engel and Blackwell 1982). This process-oriented approach, rather than outcome-oriented approach, seems useful in that, it spans the entire consumption experience and points to an important process which may lead to consumer satisfaction, with unique measures capturing unique components of each stage. This approach seems to draw more attention to perceptual, evaluative, and psychological processes that combine to generate consumer satisfaction (Yi 1990).

2.3.1 Measuring consumer satisfaction

According to Yi (1990), there are two types of methods used to measure consumer satisfaction: direct and indirect methods. Direct survey methods are the most widely used means of measuring consumer satisfaction. Their primary advantage is directness; the purpose is clear, the responses straightforward, and the corresponding rules between consumer satisfaction and measures, unequivocal. The major disadvantage of survey methods, however, is reactivity; that is, responses might be influenced by the act of measurement itself. Other problems such as

selection bias, interviewer bias, and non-response bias also provide threats to the validity of the survey data (Yi 1990).

Other methods of measuring consumer satisfaction include collecting data on consumer complaints and repeat purchases. These indirect methods are important since complaint and repeat purchase behaviors are germane to satisfaction, important to both firms and consumers, and relatively unobtrusive, resulting in reduced reactivity.

The problems encountered with those methods are the corresponding rules between the concept and the measures are ambiguous and imperfect due to confounding factors. Repeat purchase is affected not only by consumer satisfaction but also by other factors such as promotional activities, brand availability and brand loyalty (Yi 1990). These methods can be said to measure both satisfaction and other extraneous factors, since the two types of methods have different strengths, they can best be considered as complements rather than replacements to each other (Yi 1990).

Bredahl and others (1998) explained that for products to be successful, it is necessary to translate consumer demands into product specifications that are actionable from the producer's point of view. This is especially complex for food, because the way consumers perceive expected quality before a purchase is often different from the way quality is perceived after consumption. Producers find it more important to know how the objective market perceives quality and value (Cardello 1995; Lawless 1995). The Kano theory offers an effective and insightful tool to help us understand consumer satisfaction and dissatisfaction (Kano and others 1984; Shen and others 2000). It describes non-linear relationships between attributes performance and consumer satisfaction and dissatisfaction. Based on the Kano theory, consumer satisfaction and dissatisfaction are regarded as two distinct dimensional constructs within consumption behavior,

i.e. the opposite of satisfaction is not dissatisfaction, but no satisfaction, and *vice versa* (Berger and others 1993).

2.3.2 Kano theory of attractive quality

Customers' requirements and needs become more difficult to please over time due to attribute lifecycles and competition with already positioned strong brands on the market. It is therefore vital for any enterprise to find a way to conveniently discover what kind of product or service consumers want, and attributes of greater importance to them. According to Kay and Pawitra (2001), all customer requirements are not created equal. It is worthwhile to discover which product attributes are more important to the consumer, since attributes behave differently in terms of how they affect consumer satisfaction. The Kano model, developed in the late 70´s and early 80´s by Japanese quality expert Dr. Noriaki Kano, has found wide applicability in many different fields and various service and product types. According to Zultner and Mazur (2006), the Kano model challenges the traditional idea on consumer satisfaction that, "more is better", which states that, the better you perform on each product attribute, the more satisfied consumers will be. Rather, attribute performance is not equal in the eyes of consumers since certain categories of attributes produces higher levels of satisfaction than others. The Kano model proposes a two-dimensional relationship between attribute performance and consumer satisfaction involving the degree of product attribute fulfillment, and the consumer's degree of satisfaction, describing the complexities of consumer needs and the direction that efforts should go in order to delight consumers. Kano identified three major categories relating to consumer needs namely attractive, one-dimensional and must-be attributes (Bialkowski and others 2009) and also, two other minor categories; indifferent and reverse attributes (Baek and others 2009).

According to Kano's model, some product attributes can explain only dissatisfaction (must-be), others explain solely satisfaction (attractive), others explain both satisfaction and dissatisfaction (one-dimensional), others have no impact on satisfaction/dissatisfaction (indifferent) and others may indicate confusion about the product or concept (reverse).

Another important aspect is understanding the relationship between attribute relative importance and satisfaction, in order to deliver the bundle of attributes that will attract consumers to your brand. Moreover, the character and importance of each attribute may vary for different market segments. Competitors are always updating products and adding new features concomitant to changing consumer needs. Hence, finding the best fit between a products' optimal mix of attributes and customer preferences is an interactive process that should be updated on a recurrent basis (Kay and Pawitra 2001), and Kano model analysis can be applied to achieve this purpose.

2.3.3 Innovativeness and advantages of the Kano model

There are a number of advantages to classifying product attributes into attractive, must-be and one-dimensional categories (Matzler and Hinterhuber 1998). First, product attributes are better understood: those with the greatest influence on consumer's satisfaction can be identified and classified into must-be, one-dimensional and attractive attributes. Secondly, by clearly emphasizing the ineffectiveness of improving must-be attributes which are already at a satisfactory level and the significance of refining one-dimensional or attractive attributes as they have a greater impact on satisfaction levels provides invaluable solutions in trade-off situations in process-oriented product development.

More generally, must-be and one-dimensional attributes can potentially generate dissatisfaction and should first be correctly aligned with the product concept. When such sources of imminent dissatisfaction have been eliminated, attention can then be focused on optimizing one-dimensional and attractive attributes to produce greater satisfaction and differentiation. The Kano model therefore provides a strategic benefits hierarchy for developing the ideal product (Griffin and Hauser 1993; Matzler and Hinterhuber 1998), which can further be optimally combined with quality function deployment (Matzler and others 1996).

In addition, Kano's method of classifying attributes into their respective Kano categories does not require the consumer to have had experience with the attributes that are being classified, and has no technical limitations regarding the number of attributes that can be analyzed (Mikulic and Prebezac 2011). When two product requirements cannot be met simultaneously due to technical reasons or costs, a criterion can be utilized reflecting which feature has the greatest influence on satisfaction. In this situation, must-be, one-dimensional and attractive requirements will differ as a rule, by the utility expectations of different customer segments. Based on this, solutions for specific challenges can be elaborated which guarantee an optimal level of satisfaction in the different customer segments (Matzler and others 1996).

2.3.4 Limitations of the Kano model

Examination of the classic Kano attribute classification methodology reveals a number of weaknesses (Chen 2012). Although the Kano theory has engaged product developers and managers since its creation, the classic attribute Kano classification often appears incomplete. The Kano model is a conceptual theory and describes the non-linear relationship between attribute performance and consumer satisfaction/dissatisfaction. Obviously, both variables, i.e.

attribute performance and consumer attitudes (satisfaction/dissatisfaction) are defined in parametric dimensions. Nonetheless, in the classic Kano attribute classification methodology, the qualities (functional/dysfunctional) of attributes are frequently defined by a condition of the attribute's benefit or even the existence/non-existence of a feature. Plausibly, determinations on attribute Kano categories by the classic Kano methodology may be biased or misleading.

Consumers might be confused by researcher-defined quality attributes as they may conflict with their experiences or expectations. Going by the classic methodology, consumers evaluate functional and dysfunctional aspects of a product using the same scale ranging from "like" to "dislike". However, in reality, it should not be expected that a consumer's reaction to a dysfunctional attribute would utilize both ends of this scale, with the consequence of potentially increasing the risk of incorrect responses, and weakening the efficiency of attribute classification. Also with the way functionality of an attribute is defined, one would assume that, the desirable or acceptable level for an attribute should cover a range of acceptable attribute intensities within which an ideal point would occur. From the standpoint of attribute intensity levels, the functionality of an attribute can be defined by a range from minimum acceptable intensity to ideal intensity, then from the ideal intensity to maximum acceptable intensity (Li 2011). Still as shown in the literature, the Kano theory works best when attribute functional/dysfunctional quality is defined as a feature or function that is or is not existent.

The determination of attribute Kano categories based on frequencies of responses seems rather simplistic, risky and arbitrary. Due to limitations in ballot design as described above, consumer responses could be misrepresented which may cause incorrect frequency distribution in some Kano categories. Also, similar frequencies of consumer responses within two categories indicate potential consumer segmentation or poor methodology, and any decision without

considering these potential factors may be misleading. Regression techniques could be a useful tool to overcome the disadvantages and challenges in the classic Kano methodology, however they are not without their own severe limitations (Chen 2012).

Overall, Kano modeling presents a very useful tool for understanding the dynamics of human satisfaction and dissatisfaction, and differences between basic, one-dimensional and delighter drivers. Thus, its practicality and potential for use in research and development, and understanding food choices to drive product success cannot be overemphasized. Surprisingly, application of the Kano technique to improve sensory methodology and enhance understanding of perceptual frameworks has been barely reported (Riviere and others 2006; Li 2011), and remains scarce.

2.4 Studies Focusing on Food Emotions, Overall Acceptability and Satisfaction

Foods and drinks are often associated with emotions and emotions play an important role in determining food preferences and liking (Desmet and Schifferstein 2008; King and Meiselman 2010). The relationship between acceptability and emotions has been evaluated for different products and product categories and the association between them have been found to be based on the product, product category, demographics and psychographics. There is a correlation between overall acceptability and emotion terms, but acceptability and emotion scores can yield different conclusions about products and differences among products.

Porcherot and others (2010) discussed the relationship between overall product acceptability and emotions, and concluded that the information from acceptability testing is not identical with the information from emotion testing. In a study by King and others (2010), proteins such as beef, chicken and fish had few emotions associated with overall acceptability (30 emotions

unrelated out of 39) while for spices and herbs, only 13 out of the 39 emotions in the EsSense Profile® were not associated with overall acceptability. A similar response was found between genders for different product categories. For herbs/spices and carbonated and still beverages, fewer emotion terms were associated with acceptability for both genders. However, for snacks, males associated only two emotions with acceptability, *vs.* 23 for females. The differences between acceptability and emotions with proteins was partly explained by the carnivore nature of humans which may trigger a primitive emotional response to protein based foods since they are strongly associated with survival; on the other hand, one might expect a vegan to have negative emotional response to animal based foods (King and others 2010). Differences in gender response may be associated with 'gender role' discussed in Kring and Gordon (1998), where females tend to rate emotion intensities stronger than males on the average; however, this pattern is product specific and is reversed for some products. While gender studies have examined differences between male and female food preferences and food acceptability scores, emotions can provide another way to look at gender differences for products. Table 2 shows a summary of recent emotion studies related to the consumption experience.

Li and others (2014) utilized conjoint, Kano and emotion analysis to determine the factors that affected parent's choice of chocolate milk for their children. Findings indicated that reduced fat and sugar with an all-natural label, added vitamins, minerals, and protein were attractive to the majority of parents when purchasing chocolate milk for their children while the extent of their children's liking was a one-dimensional attribute. Parents reported positive emotions particularly good, good-natured, happy, and loving emotions when purchasing chocolate milk for their children. Also, higher percentages of affectionate, good-natured, happy, and loving emotions were associated more with chocolate milk compared to other dairy products, with

cottage cheese recording the lowest percentage. Kim and Lee (2015) investigated the influences of intrinsic sensory and extrinsic package/brand characteristics on consumer liking and purchase intent of orange juice products, and conducted a Kano analysis to identify package information driving satisfaction. The authors reported that orange juice flavor rather than extrinsic factors were identified as drivers of consumer liking and satisfaction. Juice products with either high or low overall sensorial acceptability scores showed minimal brand/package effects, even when a product was clearly labeled as organic.

Recently, Poonnakasem and others (2016) studied effects of different oils and health benefit statements on liking, emotion and purchase intent using the case of sponge cakes. Five positive (calm, good, happy, pleased and satisfied) and three negative emotions from the EsSense Profile® (King and Meiselman 2010) were identified as evoked by sponge cakes. Overall liking, positive emotions and purchase intent scores were positively influenced by health benefit statements while intensity of negative emotions decreased. In addition to overall liking, three emotions (pleased, calm and happy) were identified by consumers as critical to purchase intent following awareness of the health benefits of the different oils, compared to one emotion (pleased) without the benefit statements prior to that. To the best of our knowledge, no studies on the relationships between emotions and satisfaction performance of food product attributes as assessed by the Kano model have been reported in the literature, hence the need for this research.

Table 2.2 Summary of literature of food category and emotion measurement

Authors	Method	Food type	Focus
Manzocco and others (2013)	CATA	Fruit salads	Visual quality
Martinez and others (2013)	CATA	Mozzarella cheese	Flavor
Spinelli and others (2014)		Chocolate and hazelnut spreads	Overall liking, emotions, product tasting (blind vs. brand, packaging). Brand has significant effect on emotions.
Ferrarini and others (2010)	CATA	Wine	Tasting, sensory experience
King and Meiselman (2010)	CATA, EsSense	Flavored crackers, pizza, mashed potatoes, vanilla ice-cream, fried chicken, chocolate, flavors of salty snacks	
Laros and Steenkamp, (2005)	5-point emotion rating scale	GMO, Organic, Functional food, regular food	
King and others (2013)		Effect of type of questionnaire, CATA vs. rating scale –vanilla ice cream; order of emotions (random vs. alphabetical); position of emotions with respect to overall acceptability (before vs. after acceptability); product name, aroma or flavor of product – 9 spices; number of samples in CLTs-salty snack; time of day- flavors of salty snacks)	

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CHAPTER 3.
EXPLORING THE DRIVERS OF PURCHASE INTENT AND CONSUMER SATISFACTION OF CHICKEN EGGS USING PRINCIPAL COMPONENT ANALYSIS AND THE KANO MODEL

3.1 Introduction

Eggs are consumed worldwide as they are inexpensive yet provide a source of high quality protein, minerals and vitamins along with functionality to the human diet. The production of table eggs in the United States in 2011 generated 8.44 billion dollars in revenue (USDA 2013). The egg industry, therefore, occupies an important niche in the global food supply. With increased efforts to improve the quality, nutrition, safety, functionality and shelf-life of eggs, there is the need to examine the drivers of consumer satisfaction and assess the impact of emerging product attributes on purchase behavior and consumer satisfaction.

Food quality attributes are generally grouped into five major categories namely safety, nutrition, value, package, and process (Caswell 1998). For chicken eggs, quality is largely determined by the extrinsic eggshell quality as well as the internal quality, both of which are of prime economic importance to the egg industry (Roberts 2004). Eggshell quality attributes encompass shell color, size, shell deformation, shell thickness and ultrastructure among others, while interior quality is based on albumen quality, perivitelline membrane, yolk quality and the presence of blood spots (Stadelman 1995; Roberts 2004; Wardy and others 2011, 2013, 2014).

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Success of products in the marketplace warrants that, they fulfill or exceed consumer needs and expectations (Matzler and Hinterhuber 1998). However, different product attributes impact satisfaction differently; hence, prioritization of critical features is vital to the long-term success of any enterprise given limited resources (Tan and Pawitra 2001; Chen 2012). Kano and others (1984) proposed a two-dimensional attribute performance to consumer satisfaction model in contrast to a linear, one-dimensional quality model to help identify key product requirements. The Kano Model has the objective of translating the voice of the consumer into insightful categories of consumer needs (Berger and others 1993) thereby, providing guidance for product development/improvement in order to achieve enhanced consumer satisfaction as well as product differentiation from the competitors (Matzler and Hinterhuber 1998; Rivière and others 2006).

The Kano Model classifies product characteristics into six categories: must-be, attractive, one-dimensional or performance, indifferent, reverse and questionable with the first four comprising the main factors of interest (Figure 3.1) (Kano and others 1984; Berger and others 1993). Must-be attributes are vital to acceptance as they are typically expected by consumers; they could produce absolute dissatisfaction if absent and does not increase satisfaction when present (Rashid and others 2011). Attractive attributes are unique, innovative features not expected to be in the product which have the greatest influence on satisfaction, but when absent, does not necessarily cause dissatisfaction (Rivière and others 2006). One-dimensional attributes have a linear response of either enhancing the level of consumer satisfaction or dissatisfaction with high degrees of satisfaction resulting from greater attribute fulfillment and vice-versa, and are mostly demanded by the consumer, while indifferent attributes are not of much interest to the consumer and neither cause satisfaction nor dissatisfaction (Chaudha and others 2011).

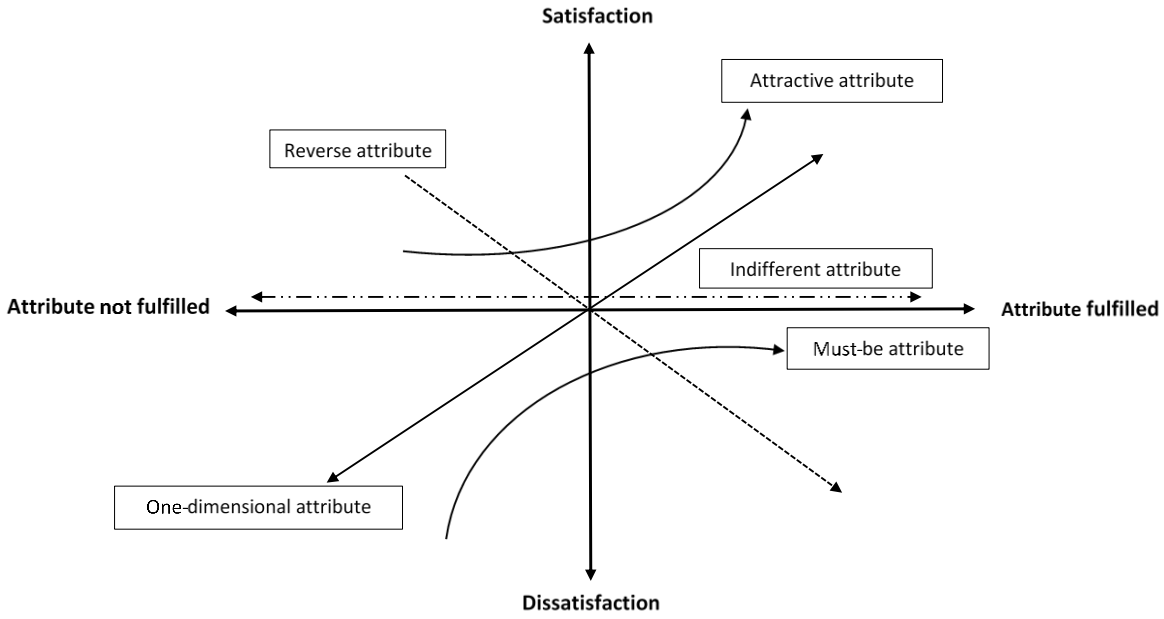

Figure 3.1 Kano's two-dimensional quality model for consumer satisfaction (Source: Kano and others 1984).

Classifying attributes in the Kano model can be achieved using various approaches including Kano's method, direct classification, qualitative data methods, penalty-reward contrast analysis, importance grid analysis and other regression methods (Mikulić and Prebežac 2011; Chen 2012). Despite the fact that, Kano's method does not measure attribute relative importance within a Kano category, it remains the best approach for classification in the Kano model since it maintains validity and high reliability for assessment of existing as well as nonexistent attributes, and also, has no technical limitations regarding the number of attributes for analysis compared to the other approaches (Mikulić and Prebežac 2011; Bi 2012; Chen 2012).

According to Kemp and others (2006), quality concerns of the egg commodity remains a persistent issue. More so, the utilization of designer eggs as functional foods with enhanced nutritional content for disease prevention continues to garner more interest in industry as well as

on the worldwide market (Rajasekaran and Kalaivani 2013). In the packing plant, egg processing operations including washing, candling, grading and packing imply high financial costs to industry, may be subject to human error (USDA 2000; De Ketelaere and others 2004) and are often devoid of the voice of the consumer. Hence, a framework for categorizing egg attributes from the consumer's viewpoint would be invaluable to the egg industry. Jibir and others (2012) identified external quality attributes of shell eggs in decreasing order of importance to Nigerian consumers as size, cleanliness, color, uniformity and texture with size and cleanliness rated higher ($P < 0.05$) than color, uniformity and texture. It is worthwhile to explore the essential attributes US consumers use to determine egg quality and their purchase decision.

The objective of this research was to investigate the extent to which selected egg attributes influence purchase intent and contribute to consumer satisfaction using the voice of the consumer, principal component analysis and the Kano method.

3.2 Materials and Methods

3.2.1 Questionnaire

This study adopted a comprehensive approach to identifying critical egg quality attributes and exploring the extent of their impact on consumer satisfaction. An overview of the process included consumer requirements acquisition and Kano model classification. The questionnaire used to collect the data consisted of three sections. The first entailed a series of questions relating to the demographic makeup of respondents and included questions concerning gender, age, race, and education. The second section contained questions to investigate important purchase motivators and the third section involved questions for determining attribute satisfiers and dissatisfiers using the Kano theory. The questionnaire was administered in person to consumers

and via online surveys where potential consumers were contacted, screened and the survey link emailed to them.

3.2.2 Survey sample

A written survey was run on a sample of 400 consumers recruited from Baton Rouge, Louisiana, USA; out of which 120 were online responses. Sample size was chosen to obtain at least a 20:1 subjects to variables ratio (Hair and others 1998). Respondents were conveniently sampled and included students, faculty and staff of Louisiana State University, members of various churches, and other consumers from Baton Rouge, Louisiana, USA. Hence applicability of results is limited to the demographics tested. Consumer screening was based on age (≥18 years), egg purchase and consumption. Of the participants, 49% were male and 51% female. Majority of respondents were White (49%), 18% were Asian, 16% were Black and 15% were Hispanic. Most participants had a college education (50%) or above (39%) with 11% having a high school education. Age distribution varied from 18 to >60 years, the median being 18-30 years.

3.2.3 Motivating consumer purchasing factors

Relevant egg quality variables were identified from literature (USDA 2000; Stadelman 1995) and screened using feedback from egg producers, poultry scientists and consumers based on their effect on perception of quality and purchase intent. A list of 20 quality attributes was generated (see Table 1). These characteristics included freshness, eggshell cleanness, shell thickness, absence of visible cracks, shell smoothness, shell glossiness, shell color, spotless eggshell, egg shape, yolk color, egg size, organic egg, package labeling information, package

type and egg grade among others. Selected quality variables were presented in the form of a randomized list to consumers and ranked on a scale of importance (1= least; 5 = most) to purchase intent.

3.2.4 Kano analytical method

The Kano Method was used to examine the extent to which product attributes contribute to the satisfaction of consumer quality requirements. The Kano questionnaire was used for product attribute classification in Kano's model. A Kano questionnaire consisting of pairs {functional (attribute fulfillment) and dysfunctional (attribute non-fulfillment)} of customer requirement questions was constructed for the 20 selected attributes using simple and clear language. For example, how do you feel when eggs are labeled organic (functional question), and how do you feel when not labeled organic (dysfunctional question). Responses (I like it, expect it, neutral, can tolerate it, or dislike it) to both questions were then used to classify egg attributes as either 'must-be', 'one-dimensional', 'attractive', 'indifferent', 'reversal' or 'questionable' (Kano and others 1984) using Kano's evaluation table as described by Matzler and Hinterhuber (1998).

3.2.5 Data analyses

Principal component analysis (PCA) was applied to attribute rankings to identify relationships between quality variables, thereby reducing them into fewer groups based on the eigenvalue criterion. Varimax rotation provided the best interpretation to factor loadings, and variables with higher loadings ($\geq \pm 0.4$; Hair and others 1998) on each principal component (PC) were used to arbitrarily assign substantive names to the PCs. Attribute rankings were standardized via the correlation (Pearson, *n*) matrix utilized in the PCA algorithm using MS

Excel with XLSTAT add-in. Cluster analysis was used to determine whether homogeneous subgroups of consumers existed based on their rankings of attribute importance to purchase intent. A two-stage procedure was utilized (Hair and others 1998). First, hierarchical cluster analysis using Ward's minimum variance method suggested a 3-cluster solution as optimum since it provided meaningful differentiation between attributes. Subsequently, *k*-means nonhierarchical clustering aimed at minimizing within-cluster variation was used to refine the 3-cluster solution. Clusters were then profiled using mean rank sums of attribute importance to purchase intent for the extracted PCs and separated using one-way analysis of variance followed by the Tukey's studentized range test at $\alpha = 0.05$. The statistical analysis software (SAS, 2003) was used for cluster analysis.

The Kano category of each attribute was determined by frequency analysis of each attribute class for all respondents (Kano and others 1984). To decrease the 'noise level' in the Kano classification of egg attributes, the traditional mode statistic was modified as suggested by Berger and others (1993). When {one-dimensional (O) + attractive (A) + must-be (M)} > {indifferent (I) + reverse (R) + questionable (Q)}, the attribute (one-dimensional or attractive or must-be) with the highest frequency was assigned as the Kano category. Otherwise, the category assigned was for one of the other attributes (indifferent or reverse or questionable) with the highest frequency. Since a high number of responses were observed for more than one Kano category per attribute, Kano analysis was also performed for selected demographic groups (male *vs.* females; ≤30 years *vs.* >30 years), and consumer subgroups derived from cluster analysis, in order to gain more differentiated results (Matzler and Hinterhuber 1998). In addition, coefficients of consumer satisfaction {SC = (A + O) / (A + O + M + I)} and dissatisfaction {DSC = [(O + M) / (A + O + M + I)] × (-1)} were computed to evaluate the average impact of the spread of

responses across must-be, one-dimensional and attractive categories of each egg attribute requirement on satisfaction (Matzler and Hinterhuber 1998). A, O, M and I are the frequencies for each attribute class and DSC is negated to highlight dissatisfaction (Chaudha and others 2011).

3.3 Results and Discussion

3.3.1 Exploring consumer perceptions influencing purchase of eggs

The survey first sought to investigate the underlying structure of egg quality characteristics deemed important to egg purchase by consumers using attribute rankings. From the principal component analysis, 5 PCs were extracted using a composite decision criteria of eigenvalues and the scree test. The eigenvalue of 0.96 for the sixth PC was lower than the latent root criterion value of 1.0 and was thus excluded. As seen from Table 3.1, the 5 PCs altogether explained 57.43% of the total variance and the total variance explained by each PC varied from 14.19% (PC1) to 8.03% (PC5) (Table 3.1). Such a seemingly low variance accounted for by the PC solution is not atypical for surveys (see, e.g., Miles and Frewer 2001).

Following varimax rotation, variables with the highest factor loadings (cutoff point: $\geq \pm 0.4$; Hair and others 1998) on each PC were selected as most representative of the PC and grouped together (Table 3.1). A factor loading represents the correlation between an attribute and its PC, and allows for variable grouping for interpretation.

Table 3.1 Principal component loadings[a] for egg quality attributes affecting purchase intent.

Variable	PC1	PC2	PC3	PC4	PC5	Communalities[b]
	Intrinsic	Aesthetic	Extrinsic	Expediency	Wholesomeness	
Availability (quantity)	0.086	0.020	0.054	**0.780**	0.102	0.629
Clean eggshell	-0.092	0.064	**0.597**	0.156	0.456	0.601
Egg grade	0.403	0.145	0.225	**0.551**	0.066	0.542
Egg shape	0.257	**0.702**	0.144	0.054	0.084	0.590
Egg size	0.214	0.129	0.201	**0.423**	0.215	0.328
Freshness	0.257	0.009	0.241	-0.017	**0.677**	0.583
Nutrient-fortified egg	**0.693**	0.326	0.173	0.116	0.033	0.631
Organic egg	**0.777**	0.026	0.147	0.004	0.006	0.626
Packing/best-before-date	0.479	0.159	-0.097	0.203	**0.539**	0.596
Product brand	0.432	0.309	0.232	**0.452**	-0.096	0.550
Sale price	-0.185	0.172	0.034	**0.638**	0.060	0.476
Secure packaging	0.397	0.269	0.348	**0.456**	-0.212	0.604
Shell color	0.067	**0.720**	0.204	0.060	-0.120	0.583
Shell glossiness	0.162	0.452	**0.684**	0.093	-0.024	0.708
Shell smoothness	0.115	0.389	**0.698**	0.105	0.069	0.668
Shell thickness	0.305	0.057	**0.698**	0.078	0.013	0.590
Spotless eggshell	0.069	**0.832**	0.179	0.142	0.141	0.769
USDA-certified farm	**0.677**	0.096	0.114	0.096	0.112	0.502
Visible cracks	-0.200	0.060	-0.038	0.059	**0.685**	0.518
Yolk color	0.387	0.338	0.355	-0.011	0.025	0.391
Sum of squares (eigenvalue)	2.838	2.562	2.425	2.055	1.606	
% variance explained	14.189	12.811	12.123	10.276	8.028	

[a]Loadings derived by principle components extraction, eigenvalue criterion and Varimax rotation; Based on 400 consumers (Males = 49%, Females = 51%). [b]Communalities derived as sum of squares of principal component loadings for a quality variable. [c]Bold principal component loadings are representative of a principal component.

The resulting groupings were arbitrarily categorized under the following names: PC1 (intrinsic quality), PC2 (aesthetic value), PC3 (extrinsic quality), PC4 (expediency and image issues) and PC5 (wholesomeness and safety concerns) (Table 3.1).

Intrinsic quality was constituted by nutrient-fortified egg (enhanced with omega-3, vitamin E, folate, etc.), organic egg (no usage of hormones, antibiotics) and USDA-certified farm eggs, and they accounted for most of the variance (14.2%). Aesthetic quality was defined by shell color (white, brown, etc.), spotless eggshell (uniform color) and egg shape (more or less oval). Tangible eggshell attributes like cleanness, thickness, surface smoothness and glossiness loaded onto extrinsic quality. Expedient/image quality consisted of type of packaging (styrofoam, cardboard, etc.), sale price, egg size, brand name, egg grade and availability while egg freshness, 'packing/best-before-date' and absence of visible cracks characterized wholesomeness and safety. The amount of variance accounted for by the PC solution for an attribute is represented by the communalities (Table 3.1). Communalities for quality variables in this study were >0.5 except for yolk color, egg size and sale price.

3.3.2 Kano classification of egg quality attributes

Bi (2012) identifies 3 major Kano categories as: must-be attributes (dissatisfiers), one-dimensional attributes (more is better) and attractive attributes (enhancers). To achieve the highest level of consumer satisfaction with a product, Kano attributes must be prioritized in decreasing order of importance as must-be, one-dimensional, attractive and indifferent (Berger and others 1993). Based on the modified mode statistic (Berger and others 1993), consumers (N = 400) classified all egg quality variables into 4 (must-be, one-dimensional, attractive and indifferent) of the 6 Kano categories (Table 3.2). There were eight must-be attributes: egg

freshness, cleanness, absence of cracks, ‘packing/best-before-date’, USDA-certified farm eggs, secure packaging, egg grade and availability. Sale price emerged as the only one-dimensional attribute and egg size as an attractive attribute. The other 10 variables were classified as indifferent attributes.

Effects of demographic characteristics such as age and gender on Kano classification of egg quality attributes were observed in this study (Table 3.3). Comparing the total consumer sample to selected demographic segments, 6 egg attributes had a different Kano category (Table 3.3 *vs.* 3.2). Specifically for males and younger consumers (<30 years), must-be attributes namely USDA-certified farm eggs and egg grade became indifferent attributes, and absence of cracks became a one-dimensional attribute; whereas females considered availability (quantity) as a one-dimensional attribute. Also, the attractive attribute of egg size became an indifferent attribute for younger consumers while the indifferent attribute, product brand was classified as a must-be requirement by females (Tables 3.3 *vs.* 3.2). Considering the gender and age of consumers, Kano classification by males differed from that of females in 5 egg attributes while that of younger consumers differed from that of older (>30 years) consumers in 4 egg attributes (Table 3.3). Females showed more brand loyalty and concern about egg quality and safety than males (indifferent *vs.* must-be for brand, egg grade and USDA-certified farm eggs) (Table 3.3). Hence, processors may increase their share of markets with a higher proportion of females than males by promoting a brand name. Comparing younger *vs.* older consumers, egg size and egg grade were both rather unimportant for the former *vs.* attractive and must-be, respectively, for the latter (Table 3.3).

Table 3.2 Kano classification of egg quality attributes for all consumers (*N* = 400)

Attribute	A	O	M	I	R	Q	A+0+M	I+Q+R	Category[b]
Availability (quantity)	41	119	**131**[a]	104	0	5	291	109	M
Clean eggshell	35	110	**160**	83	1	11	305	95	M
Egg grade	57	48	**101**	189	3	2	206	194	M
Egg shape	49	23	51	**272**	1	4	123	277	I
Egg size	93	70	47	**178**	6	6	210	190	**A**
Freshness	24	161	**181**	26	1	7	366	34	M
Nutrient-fortified egg	64	37	29	**243**	17	10	130	270	I
Organic egg	79	38	19	**245**	16	3	136	264	I
Packing/best-before-date	23	**108**	171	89	2	7	302	98	M
Product brand	28	35	**109**	220	3	5	144	228	I
Sale price	52	**175**	93	75	2	3	320	80	O
Secure packaging	27	79	**193**	97	1	3	299	101	M
Shell color	56	31	25	**250**	31	7	112	288	I
Shell glossiness	36	15	23	**310**	9	7	74	326	I
Shell smoothness	59	28	45	**258**	5	5	132	268	I
Shell thickness	31	32	74	**255**	5	3	137	263	I
Spotless eggshell	47	58	55	**230**	4	6	160	240	I
USDA-certified farm	55	59	95	**185**	3	3	209	191	**M**
Visible cracks	20	158	**169**	40	4	9	347	53	M
Yolk color	49	24	30	**243**	34	20	103	297	I

[a]Kano category (bolded values) of egg quality variables determined by highest frequency. A = attractive attributes; O = one-dimensional attributes; M = must-be attributes; I = indifferent attributes; R = reversal attributes; Q = questionable attributes.
[b]Kano category using the modified mode statistic. When {one-dimensional (O) + attractive (A) + must-be (M)} > {indifferent (I) + reverse (R) + questionable (Q)}, the attribute (M or A or O) with the maximum frequency was assigned as the Kano category. Otherwise, the 'attribute' assigned was for one of the other attributes (I or R or Q). Bolded categories are different from that obtained using the traditional method.

Table 3.3 Kano summary table for selected demographic groups (N = 400)

Attribute	Gender						Age, years					
	Males (n = 194)			Females (n = 206)			18-30 (n = 299)			>30 (n = 101)		
	Category[a]	SC[b]	DSC[b]	Category	SC	DSC	Category	SC	DSC	Category	SC	DSC
Availability (quantity)	M	0.37	0.59	O	0.44	0.68	M	0.41	0.61	M	0.38	0.70
Clean eggshell	M	0.38	0.69	M	0.37	0.70	M	0.39	0.68	M	0.34	0.74
Egg grade	I	0.22	0.34	M	0.31	0.41	I	0.25	0.34	M	0.31	0.49
Egg shape	I	0.18	0.18	I	0.18	0.19	I	0.18	0.19	I	0.19	0.19
Egg size	A	0.44	0.30	A	0.41	0.30	I	0.40	0.28	A	0.48	0.35
Freshness	M	0.46	0.86	M	0.49	0.89	M	0.49	0.86	M	0.43	0.91
Nutrient-fortified egg	I	0.32	0.15	I	0.23	0.20	I	0.29	0.18	I	0.23	0.17
Organic egg	I	0.28	0.11	I	0.33	0.18	I	0.32	0.16	I	0.26	0.12
Packing/best-before-date	M	0.31	0.65	M	0.36	0.78	M	0.34	0.71	M	0.31	0.74
Product brand	I	0.14	0.29	M	0.18	0.44	I	0.15	0.37	I	0.19	0.36
Sale price	O	0.57	0.65	O	0.58	0.70	O	0.60	0.67	O	0.50	0.69
Secure packaging	M	0.27	0.66	M	0.26	0.71	M	0.27	0.68	M	0.25	0.71
Shell color	I	0.25	0.13	I	0.24	0.18	I	0.26	0.17	I	0.19	0.11
Shell glossiness	I	0.13	0.07	I	0.13	0.13	I	0.14	0.11	I	0.10	0.06
Shell smoothness	I	0.21	0.17	I	0.24	0.21	I	0.23	0.20	I	0.20	0.16
Shell thickness	I	0.16	0.23	I	0.16	0.31	I	0.16	0.27	I	0.16	0.28
Spotless eggshell	I	0.26	0.28	I	0.27	0.29	I	0.29	0.32	I	0.19	0.19
USDA-certified farm	I	0.26	0.35	M	0.32	0.43	I	0.28	0.37	M	0.31	0.45
Visible cracks	O	0.47	0.82	M	0.45	0.87	O	0.49	0.84	M	0.38	0.86
Yolk color	I	0.21	0.14	I	0.21	0.17	I	0.20	0.16	I	0.23	0.16

[a]Kano category of egg quality variables using the modified mode statistic (See Table 3.2 for details). [b]Consumer satisfaction coefficients [SC, satisfaction (+); DSC, dissatisfaction (-)].

Interestingly, all consumers were indifferent to eggs being organic or having superior nutrition regardless of gender and age of consumers (Table 3.3 *vs.* 3.2). It therefore seems doubtful that, consumers would pay more for organic or designer eggs despite perceived health benefits. Magnusson and others (2003) reported a more positive attitude towards organic foods by younger Swedish consumers compared to older consumers. In the present study, % top 2-box for organic and nutrient-fortified eggs were 43 and 39 %, and were ranked as moderately important to purchase intent with mean rank sums of 3.1 and 3.0, respectively, out of 5 (Figure 3.2).

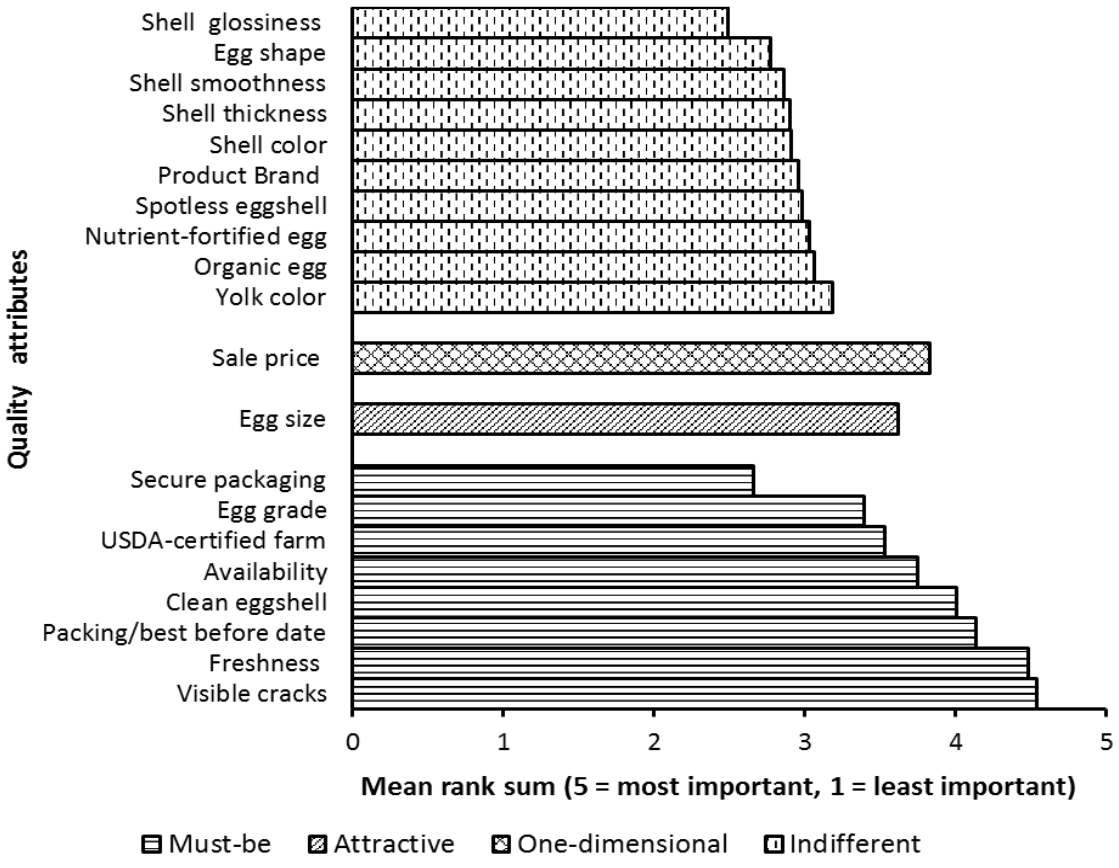

Figure 3.2 Importance of egg quality attributes affecting purchase decision by Kano categories for all consumers (N = 400)

They were thus, considered relatively more important among indifferent attributes. Nonetheless, attractive, one-dimensional and must-be attributes were generally accorded greater importance to purchase intent with % top 2-box of 58 (egg size), 69 (sale price), and 26 (secure packaging) – 88 % (egg freshness) respectively, *vs.* 21 (shell glossiness) – 45 % (yolk color) for indifferent attributes (data not shown).

Cluster analysis identified 3 clusters (CL) within the current study population based on rankings of attribute importance to purchase intent. As seen from Table 3.4, CL2 comprised consumers who placed greater importance on some quality variables than those in CL1 and CL3; and consumers in CL3 regarded intrinsic and aesthetic features as being more important ($P < 0.05$) to purchase intent compared to those in CL1. Comparing % top 2–box for the various PCs, a similar trend to that of mean rank sums was observed across clusters (Table 3.4). A key demographic characteristic differentiating clusters was the greater proportion of non-Caucasians in CL2 (Table 3.5).

Table 3.4 Mean importance rankings of egg quality attributes to purchase intent within clusters* by principal components ($N = 400$)

PC	Cluster 1 ($n = 79$)	Cluster 2 ($n = 151$)	Cluster 3 ($n = 170$)
Intrinsic	1.91^{c}	3.95^{a}	3.14^{b}
% top 2-box**	14	69	40
Aesthetic	1.94^{c}	3.75^{a}	2.57^{b}
% top 2-box	12	64	24
Extrinsic	2.19^{b}	3.79^{a}	2.83^{ab}
% top 2-box	20	62	29
Expediency	2.64^{b}	4.01^{a}	3.13^{ab}
% top 2-box	30	71	42
Wholesomeness	3.92^{a}	4.63^{a}	4.38^{a}
% top 2-box	69	92	84

*Clustering based on rankings of attribute importance (1 = least important, 5 = most important) to purchase intent. ** % Top 2-box indicates proportion of ‘‘5 = most important’’ and ‘‘4 = very much important responses.

[a-c]Means with different superscript letters were significantly different ($P < 0.05$) across clusters.

Table 3.5 Demographic profile of clusters (N = 400)

Demographic	Description	Cluster 1 (n = 79) n (%)	Cluster 2 (n = 151) n (%)	Cluster 3 (n = 170) n (%)
Gender	Male	40 (51)	75 (50)	79 (46)
	Female	39 (49)	76 (50)	91(54)
Age, years	18-30	52 (65)	115 (76)	132 (77)
	>30	27 (35)	36 (24)	38(23)
Ethnicity	Caucasian	49 (62)	49 (32)	97 (57)
	Non-Caucasian	30 (38)	102 (68)	73 (43)
Education	High school	8 (10)	22 (15)	15 (9)
	College	38 (48)	74 (49)	86 (50)
	Graduate degree	33 (42)	55 (36)	69 (41)

Compared to the total sample, Kano classification of egg attributes within the 3 consumer subgroups differed for 6 egg attributes (Table 3.6 *vs.* 3.2). The most pertinent differences were observed in CL2 where absence of cracks and spotless eggshell were one-dimensional attributes and product brand was a must-be attribute (Table 3.6 *vs.* 3.2). In addition, egg size and egg grade, both important quality attributes used by industry for grading, were unimportant for CL3 (Table 3.6). It was also apparent by observing differences between Tables 3.6 and 3.3 *vs.* Table 3.2 that, gender, age and ethnicity of consumers jointly influenced the Kano classification of egg quality attributes such as visible cracks, egg size, product brand and egg grade, and this may be due to their different attitudes, cultural preferences or experiences. Further research on possible effects of gender, age, and ethnicity on consumer attitudes and purchase behavior of eggs may be useful for verifying observed trends.

Table 3.6 Kano summary table for consumer subgroups (N = 400)

Attribute	Cluster 1 (n = 79)			Cluster 2 (n = 151)			Cluster 3 (n = 170)		
	Category[a]	SC[b]	DSC[b]	Category	SC	DSC	Category	SC	DSC
Availability (quantity)	M	0.34	0.62	M	0.45	0.64	M	0.40	0.64
Clean eggshell	M	0.31	0.65	M	0.44	0.76	M	0.35	0.66
Egg grade	I	0.13	0.37	M	0.35	0.48	I	0.25	0.29
Egg shape	I	0.13	0.11	I	0.27	0.28	I	0.12	0.14
Egg size	A	0.47	0.30	A	0.46	0.36	I	0.37	0.25
Freshness	M	0.43	0.88	M	0.47	0.86	M	0.49	0.88
Nutrient-fortified egg	I	0.17	0.03	I	0.38	0.28	I	0.22	0.15
Organic egg	I	0.13	0.04	I	0.39	0.21	I	0.31	0.14
Packing/best-before-date	M	0.28	0.60	M	0.40	0.73	M	0.30	0.75
Product brand	I	0.10	0.30	M	0.23	0.44	I	0.12	0.33
Sale price	O	0.57	0.81	O	0.58	0.66	O	0.57	0.64
Secure packaging	M	0.19	0.66	M	0.33	0.68	M	0.24	0.70
Shell color	I	0.26	0.12	I	0.31	0.24	I	0.17	0.10
Shell glossiness	I	0.07	0.04	I	0.20	0.15	I	0.10	0.08
Shell smoothness	I	0.19	0.12	I	0.29	0.31	I	0.18	0.11
Shell thickness	I	0.13	0.28	I	0.22	0.30	I	0.13	0.24
Spotless eggshell	I	0.24	0.12	O	0.37	0.39	I	0.20	0.28
USDA-certified farm	I	0.20	0.28	M	0.35	0.48	M	0.28	0.36
Visible cracks	M	0.40	0.89	O	0.46	0.77	M	0.49	0.89
Yolk color	I	0.15	0.10	I	0.24	0.21	I	0.21	0.13

[a]Kano category of egg quality variables using the modified mode statistic (See Table 3.2 for details).
[b]Consumer satisfaction coefficients [SC, satisfaction (+); DSC, dissatisfaction (-)]

To summarize, Kano analysis revealed such basic requirements for consumer satisfaction as freshness, cleanness, absence of cracks, detailed labeling information, secure packaging and availability to go along with large sizes and competitive pricing, and processors need to prioritize these in order to get consumers to commit to their product brand.

3.3.3 Degree of consumer satisfaction and dissatisfaction

Various authors have suggested using satisfaction coefficients to quantify the impact of attribute fulfillment or non-fulfillment on consumer satisfaction (Berger and others 1993; Matzler and Hinterhuber 1998; Chaudha and others 2011). As seen from Figure 3.2, using satisfaction coefficients (SC, satisfaction; DSC, dissatisfaction), a two-dimensional plot can be obtained depicting must-be, attractive, one-dimensional and indifferent quality elements (Berger and others 1993; Chaudha and others 2011). SC describes the degree to which consumer satisfaction is increased by fulfilling a quality attribute while DSC indicates the extent of dissatisfaction if the feature is not provided. SC (+) and DSC (-) ranges from 0 to 1; the closer the coefficient is to 1, the higher the impact on consumer satisfaction and dissatisfaction respectively (Chaudha and others 2011).

Based on satisfaction coefficients for the total sample (N = 400), egg quality requirements were positioned in Kano categories similar to that in the preceding section (Table 3.2) except for egg size, USDA-certified farm eggs and egg grade which were placed in the indifferent dimension (Figure 3.3). Overall, must-be and one-dimensional attributes namely; freshness, cleanness, absence of cracks, sale price and availability where associated with higher SC values than indifferent attributes, and, therefore, have greater impact on increasing consumer satisfaction and preventing dissatisfaction with eggs (Figure 3.3).

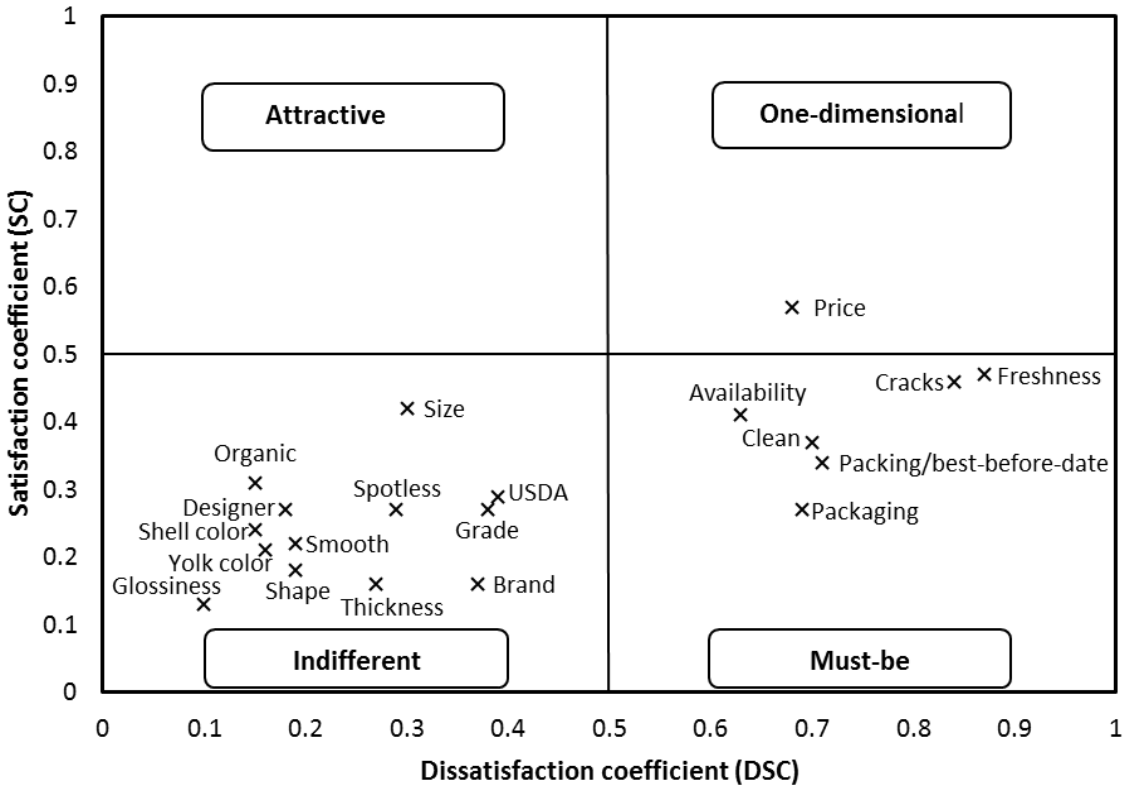

Figure 3.3 Kano egg quality categories according to their satisfaction coefficients for all consumers (N = 400).

Consequently, among must-be and one-dimensional attributes, freshness and absence of cracks were arbitrarily classified as more 'critical' (SC, ≥ 0.4; DSC, > 0.8) determinants of consumer satisfaction (Figure 3.3). For attributes in the indifferent dimension; egg size, USDA-certified farm eggs, egg grade and spotless eggshell were considered as more 'beneficial' (SC, > 0.2; DSC, > 0.2) to consumer satisfaction relative to the others (Figure 3.3).

The gender and age of consumers had minimal effects on the drivers of satisfaction as determined using the total consumer sample (Table 3.3 *vs*. Figure 3.3). Furthermore, nutrient-

fortified eggs and shell smoothness were identified as additional 'beneficial' (SC, > 0.2; DSC, > 0.2) indifferent attributes for females, and shell smoothness for younger consumers (Table 3.3 *vs.* Figure 3.3). Regarding gender, females generally reported greater dissatisfaction with non-fulfillment of egg attributes than males. For example, for organic eggs, egg grade, shell thickness, USDA-certified farm eggs, availability, 'packing/best-before-date' and product brand, female dissatisfaction was much greater (7-15%) than that of males (Table 3.3). Also, comparing younger *vs.* older consumers, satisfaction of the latter seemed to be more affected by egg grade and USDA-certified farm eggs than the former (Table 3.3).

Within the 3 clusters, drivers of satisfaction were identical to those in the total consumer sample (Table 3.6 *vs.* Figure 3.3). However, sale price was also a 'critical' driver of satisfaction (SC, ≥ 0.4; DSC, > 0.8) for CL1 in addition to freshness and absence of cracks, and this may be due to its higher proportion of older consumers (Table 3.5). Overall, satisfaction coefficients for consumers in CL2 were slightly higher than for CL1 and CL3 except for freshness, absence of cracks and sale price (Table 3.6). More so, in addition to the already identified 'beneficial' attributes from the total sample, all other indifferent attributes with the exception of shell glossiness, which may indicate coatings applied to the eggshell to extend shelf-life (Wardy and others 2013), were 'beneficial' (SC, > 0.2; DSC, > 0.2) to consumer satisfaction in CL2 (Table 3.6). Demographic differences in age and ethnicity (CL2 comprising more non-Caucasians) may be responsible for observed differences between the clusters (Table 3.5 and 3.6); further studies focused on consumer attitudes are needed for verifying observed trends.

3.3.4 Implications

The final implication of this research concerns the relation between fundamental consumer perceptions of egg quality as determined by PCA and their subsequent prioritization in the product development process by the egg processor according to their Kano categories.

For all consumers, wholesomeness characteristics seemed essential as they were all must-be requirements with the highest mean rank sums (Figure 3.2). In addition, wholesomeness was the only PC that was not significantly different ($P \geq 0.05$) between the 3 clusters (Table 3.4), suggesting that, safety concerns were critical purchase motivators. Expediency features were also vital as well since they corresponded to must-be, attractive and one-dimensional Kano categories except for product brand which was an indifferent attribute. Egg grade and weight/size constitute important aspects of US standards of grading for shell eggs (USDA 2000) and they were classified by consumers as expedient must-be and attractive attributes, respectively. According to Jibir and others (2012), consumer preference is often for large and extra-large eggs, and a large egg size was found to be a 'delighter' in this study.

Aesthetic and extrinsic egg quality features were mainly indifferent Kano attributes and had lower positive effects on purchase decision and consumer satisfaction relative to the other Kano attributes (Figure 3.2). Aesthetic egg features like egg shape and shell color, often dependent on the genetics of the hens are, therefore, not likely to influence consumer satisfaction. Shell cleanness was the only extrinsic must-be attribute and this indicates possible consumer awareness of bacteria presence, spoilage or other health concerns associated with dirty eggs. Furthermore, intrinsic variables relating to nutrient enhancements and organic eggs, though classified as indifferent, tend to echo superior and desirable egg qualities, particularly, optimum nutrition, and may offer the best returns on investment for the processor looking to get ahead of

the competition as reflected in their consumer satisfaction coefficients and mean importance rankings. Since consumer needs change and product attributes generally evolve from indifferent to attractive, one-dimensional and then to must-be attributes over time (Chaudha and others 2011), some indifferent attributes may well hold the key to ensuring that, consumers remain satisfied with a product brand.

Future studies combining both consumer demographic information and attitude analyses (Giménez and others 2008; Carrillo and others 2011; Gadioli and others 2013) are recommended as it would provide greater benefit and further assist the egg industry to satisfy consumer needs and maximize profits.

3.4 Conclusions

This study demonstrated that wholesomeness and expedient attributes emphasizing convenience and safety emerged as more important in attracting and satisfying consumers than intrinsic 'organic and nutritionally enhanced' attributes. Egg grading and product branding associated with high financial costs to industry seemed of lesser importance compared to sound, clean and securely-packaged eggs for preventing consumer dissatisfaction while lower sale prices and larger egg sizes had the greatest influence on enhancing consumer satisfaction. Processors will, therefore, stand to benefit by first ensuring a wholesome low-cost product and then, tailoring selected product attributes to cater for specific segments of the population. Indifferent 'organic and nutritionally enhanced' attributes may, however, serve as important discriminating variables for success in target markets.

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CHAPTER 4.
ASSESSING CONSUMER EMOTIONAL RESPONSES IN THE PRESENCE AND ABSENCE OF CRITICAL QUALITY ATTRIBUTES: A CASE STUDY WITH CHICKEN EGGS

4.1 Introduction

Food affects our mood, and emotions elicited by products may influence consumer attitudes, food choices, liking and purchase intent (Jiang and others 2014; Thomson and Crocker 2013). According to Desmet and Hekkert (2007), the product experience framework comprises sensory characteristics, cognition and appraisal, and emotional experiences. Sources of food emotions include sensory attributes, experienced and anticipated consequences, individual meaning (personal/cultural) and actions of associated agents (Desmet and Schifferstein 2008). In today's competitive marketplace, emotions may be a greater contributory factor to purchase decision than sensory liking and price, providing product differentiation as the phenomenon of product homogeneity is now commonplace (Jiang and others 2014).

Understanding what product features can elicit negative emotions is crucial to product development as this knowledge can help prevent a negative emotional impact of the product, and thus reduce the impact of negative stimuli, disappointed users, complaints, brand damage and shrinking sales (Desmet and Hekkert 2009). In addition, it can enhance our understanding of what promotes consumer acceptance and satisfaction with a particular food product.

"This chapter previously appeared as [Wisdom Wardy, Amporn SaeEaw, Sujinda Sriwattana, Hong Kyoon No, Witoon Prinyawiwatkul. (2015). Assessing Consumer Emotional Responses in the Presence and Absence of Critical Quality Attributes: A Case Study with Chicken Eggs. Journal of Food Science, 80, S1574–S1582]. It is reprinted by permission of [John Wiley and Sons, Copyright (2015)]."

However, consumers do not just react to products but also, to associated conceptualizations that give meaning to what is being experienced. These conceptualizations have been reduced to three broad categories – functional, emotional and abstract (Thomson and others 2010). In conceptualizing products, however, assessing the effects of both attribute presence and absence may offer greater insights into emotional associations.

Eggs are one of the few foods consumed across different cultures worldwide owing to their low cost and superior nutrition. Global production of hen eggs was estimated at 66.4 million tonnes in 2012 (FAO 2013). The production of eggs in the United States had a value of 8.50 billion dollars in 2013 (USDA 2014). The egg industry, therefore, occupies an important niche in the global food supply. Eggshell quality attributes encompass shell color, size, shell deformation, shell thickness and ultrastructure among others, while interior quality is based on albumen quality, perivitelline membrane, yolk quality and the presence of blood spots (Stadelman 1995; Roberts 2004; Wardy and others 2011, 2014a, 2014b). However, for chicken eggs at the point of sale, consumer appraisals of quality that evoke emotions may be influenced more by the extrinsic eggshell quality and stated benefits, rather than the internal quality. More so, the utilization of designer eggs as functional foods with enhanced nutritional content for disease prevention continues to garner more interest in industry as well as on the worldwide market (Rajasekaran and Kalaivani 2013). Eggs, as with most other food products, are highly variable and do not always possess the attributes expected by consumers. Hence, evaluating emotions elicited by egg attributes when attribute presence is immediately contrasted with attribute absence may yield more insightful responses. Therefore, it offers a convenient prototype to assess moderating effects of attribute presence *vs.* absence on consumer emotional responses associated with foods.

Furthermore, research on emotions associated with eggs remains very limited. Questions remain as to how consumers respond emotionally to egg products and what quality attributes (design, benefits, packaging, etc.) trigger emotional reactions. Since emotion associative profiles may vary depending on the product category (Piqueras-Fiszman and Jaeger 2014), assessing the impact of egg attributes on consumer emotions would be invaluable to the egg industry as it provides a sound basis for understanding the factors affecting purchase intent, acceptance and satisfaction.

Thus, the objective of this research was to assess the effects of presence *vs.* absence of quality attributes on the overall emotional profile and consumer acceptance of the product, using chicken eggs as an example.

4.2 Materials and Methods

4.2.1 Survey sample

The research protocol for this study was approved (IRB# HE 15-9) by the Louisiana State University (LSU) Agricultural Center Institutional Review Board. Participants included students, faculty and staff of LSU, members of various churches, and other consumers from Louisiana, USA. Consumer screening was based on age (≥18 years), egg purchase and consumption, resulting in 320 usable responses.

Of the 320 participants, 57% were female and 43% male. The majority of respondents were White (69%), 12% were Black, 8% were Asian, 6% were Hispanic, and another 5% belonged to ‘‘other’’ race. 60% of participants had a college education or above, with 40% having a high school education. Age distribution varied from 18 to >55years, the median being 35-54 years.

Concerning purchase frequency, the majority (62%) bought eggs at least once every 2 weeks, with 28% buying at least once every month and 10% buying at least once every 2 months.

4.2.2 Selection of emotion terms and egg quality attributes

Emotion terms from the EsSense Profile® (King and Meiselman 2010) for the measurement of food-related emotions were screened for relevance to the egg product category using CATA (*n* = 24). The consumer panel comprised frequent buyers who were aware of varying egg qualities. Emotion terms selected by ≥20% of research participants are considered to have some association with foods (King and Meiselman 2010). Therefore, emotion terms with a frequency of 20% or higher were selected, resulting in a final list of 20 descriptors. These included positive (active, adventurous, calm, energetic, friendly, good, happy, interested, loving, peaceful, satisfied, safe, steady, warm, whole), neither positive nor negative (nostalgia), and negative (bored, disgusted, worry, guilty) terms (Jiang and others 2014). 'Secure' was subjectively modified to 'safe', since the latter was considered to be more appropriate to the eggs than the former.

The presence and absence of 5 types of quality attributes of the egg product were utilized as stimuli to evoke and measure emotions. Egg attributes namely intrinsic, aesthetic, extrinsic, expediency and wholesome/safety, each a collective grouping of various quality characteristics as described by Wardy and others (2014a), were evaluated (see footnote of Table 4.1 for description of egg quality attributes).

4.2.3 Measurements of consumer emotions and acceptability

The questionnaire for this study consisted of 6 sections. Demographic information of participants was collected in the first section and included questions about gender, age, education, race/ethnicity and egg purchase frequency. In the subsequent sections, each of the five egg attributes were randomly presented to participants. Questionnaires were administered via a web link using an internet survey tool (Toluna QuickSurveys™; Toluna SAS, Levallois-Perret, France), and typically took 10-15 min to complete.

Figure 4.1 illustrates the sequence of evaluation utilized in the study for a specific egg quality attribute. A brief description was provided for the presence and absence of egg quality attributes. Using pictures as an aid, consumer acceptability (a 9-point hedonic scale, 1 = dislike extremely, 5 = neither dislike nor like, 9 = like extremely; Peryam and Pilgrim 1957), and the intensities of the emotion terms were rated (1 = not at all; 2 = slightly; 3 = moderately; 4 = very; 5 = extremely; King and Meiselman 2010) as elicited by the presence or absence of egg quality attributes. Emotion terms were listed alphabetically for evaluation, and attribute absence was consistently evaluated after presence.

The use of descriptive text and images *vs.* actual product as stimuli for the measurement of food associated affective state has been reported, and is rationalized as it produces repeatable results, is less costly and offers a more convenient representation of products especially for online questionnaires (Piqueras-Fiszman and Jaeger 2014; Manzocco and others 2013; Barthomeuf and others 2009; Rousset and others 2005).

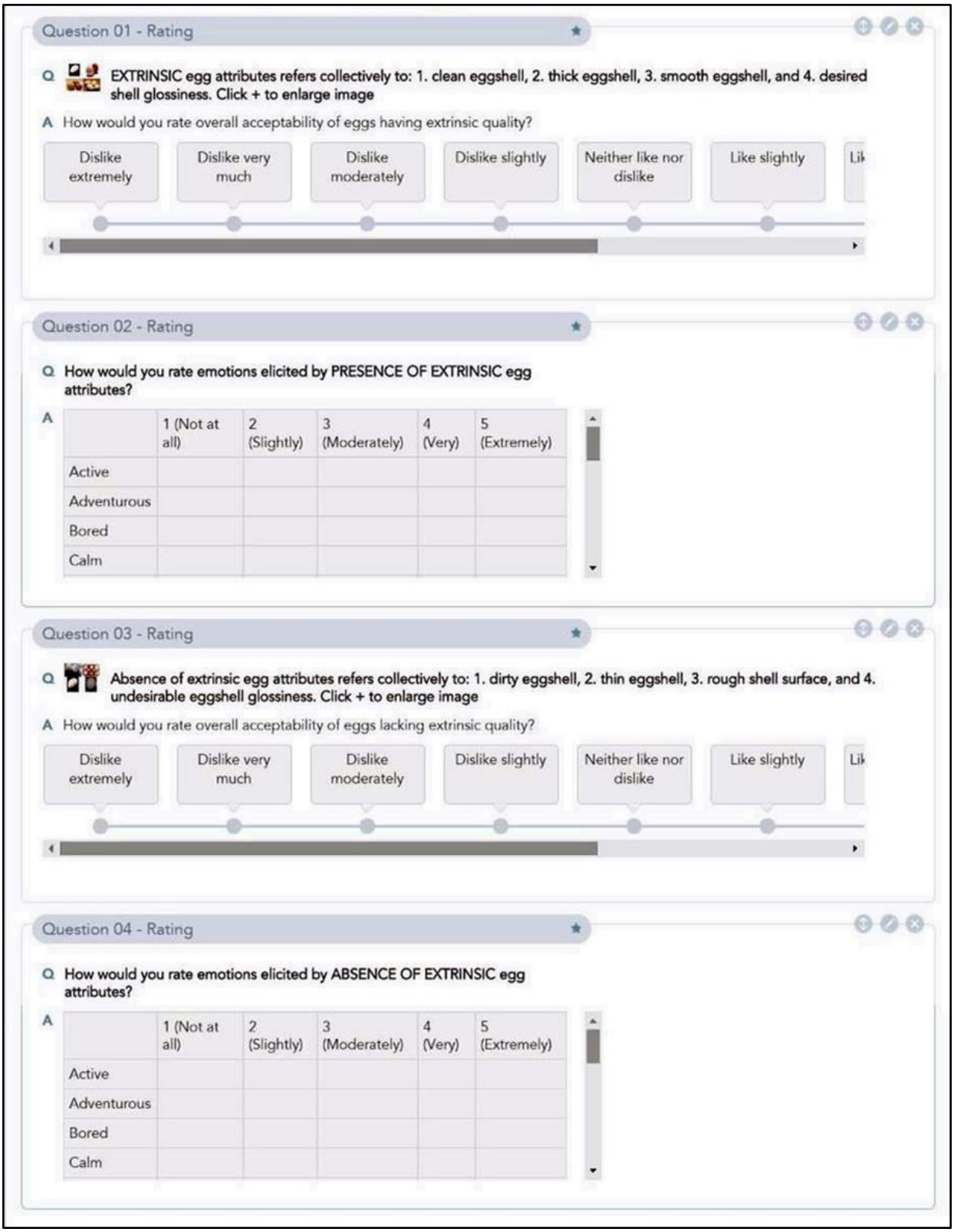

Figure 4.1 Sample consumer online ballot for evaluating overall acceptability and emotions

4.2.4 Data analyses

Dependent t-tests were used to compare emotion intensities and product acceptability within a quality grouping as affected by the presence and absence of egg attributes. Multivariate analysis of variance (MANOVA) was used to determine whether an overall difference existed among 10 egg quality groupings (5 groupings of egg attributes * presence/absence), and for 5 egg quality groupings (presence or absence) considering all 20 emotion terms simultaneously.

Subsequently, Descriptive Discriminant Analysis (DDA, Huberty 1994) was used to determine emotions largely responsible for the underlying difference among egg products with different quality attributes. Emotions with higher canonical correlations ($\geq \pm 0.5$) were arbitrarily used to define importance in discriminating among egg quality groupings. Analysis of variance followed by Tukey's *post-hoc* test was used to determine differences in emotions and acceptability for all attributes when present, absent, and also for within group differences for discriminating emotions from DDA. Pearson correlation coefficients (r) between emotions and acceptability scores were computed. The above analyses were performed at $\alpha = 0.05$ using the Statistical Analysis Software version 9.1.3 (SAS® Inst. 2003). Principal component analysis (PCA) was used to elucidate the correlation among emotions, egg quality variables, and between emotions and quality variables, as illustrated in a product-attribute correlation bi-plot using MS Excel© 2010 (Microsoft Corporation).

4.3 Results

4.3.1 Emotions elicited by presence or absence of egg attributes

As seen from Figure 4.2, effects of the presence or absence of egg quality attributes resulted in differences ($P < 0.05$) in intensity of emotions experienced by consumers, except for bored and nostalgia emotion elicited by aesthetic attributes. Generally, positive emotions were experienced with a greater intensity than negative emotions in the presence of egg attributes, and *vice versa* in their absence. Expedient and wholesome attributes generally elicited higher emotion intensities for the presence of egg attributes, compared to intrinsic and aesthetic for attribute absence; relative to the other egg attributes (Tables 4.1 and 4.2). Mean emotion intensities elicited by the presence of all quality attributes ranged from a low of 1.67 (intrinsic; guilty) to a high of 4.05 (wholesome; good) *vs.* 2.01 (wholesome; satisfied) to 3.29 (wholesome; worried) when absent (Tables 4.1 and 4.2).

For attribute presence, key positive emotions were good, safe and satisfied, as they consistently had the 3 highest intensity ratings for all attributes (Table 4.1). However, the number of other positive emotions that were experienced with an intensity greater than moderate ($\geq$ 3.5 on a 5-point scale) differed for the 5 quality attributes (Table 4.1). Comparing other positive emotions with greater than moderate intensity; 5 were elicited by wholesome attributes (interested, happy, friendly, whole, calm), 4 by expedient attributes (interested, happy, friendly, whole), 3 by intrinsic attributes (safe, good, satisfied), 2 by aesthetic attributes (interested, happy) and none for extrinsic attributes (Table 4.1).

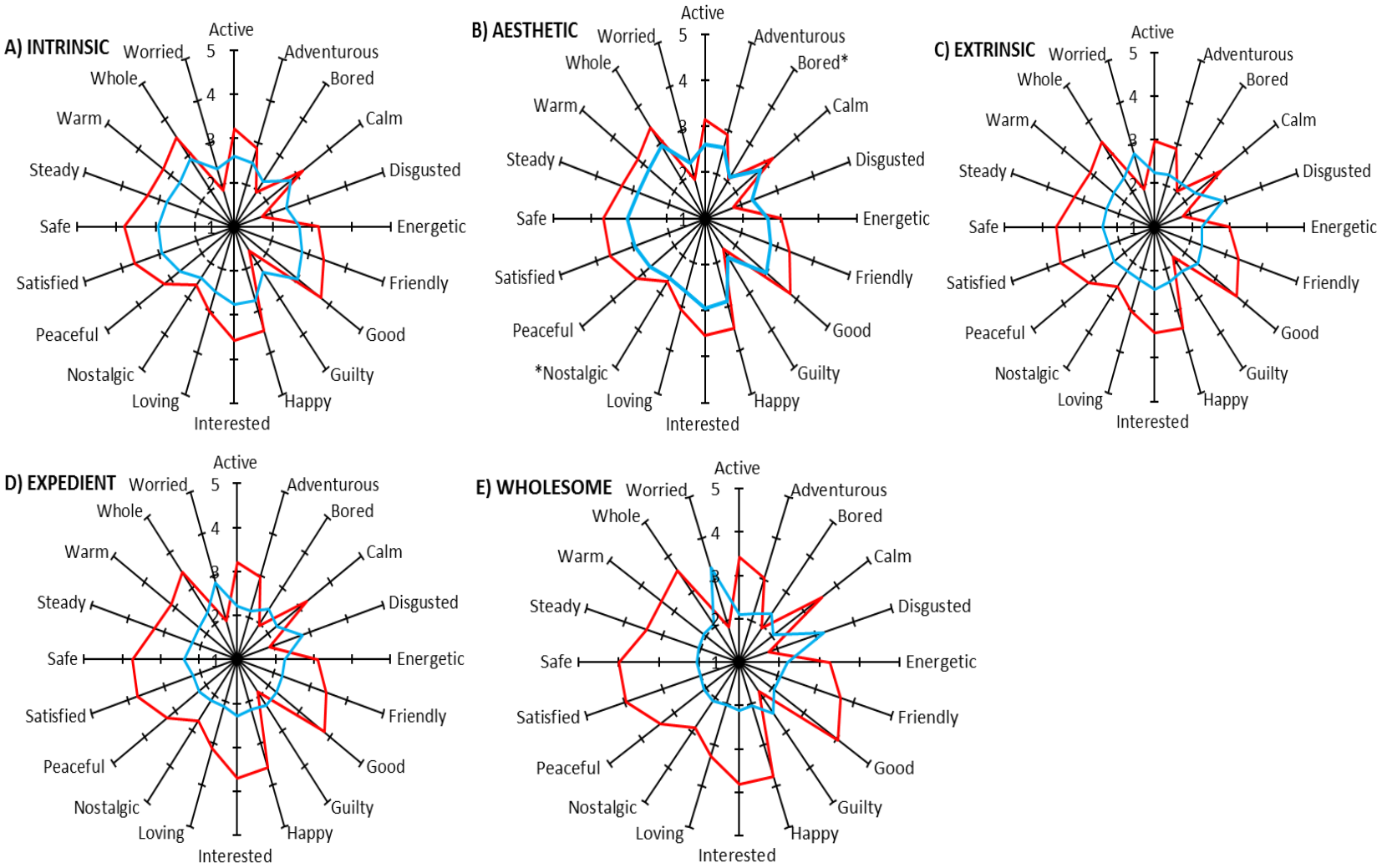

Figure 4.2 Effects of attribute presence and absence on the emotion profile (1 = not at all; 5 = extremely) of eggs with different quality (N = 320). For all charts, (—) = presence; (—) = absence of egg quality attributes. *Emotions were not significantly different ($P \geq 0.05$; a t-test) for attribute presence vs. absence. See the footnote of Table 4.1 for attribute description [Intrinsic, Aesthetic, Extrinsic, Expedient and Wholesome].

Table 4.1 Emotion intensities elicited by the presence of various egg quality attributes[†] (N = 320)

Emotions	Intrinsic	Aesthetic	Extrinsic	Expedient	Wholesome
Active	3.23^{ab}	3.14^{b}	2.97^{b}	3.20^{ab}	3.43^{a}
Adventurous	2.88^{a}	2.90^{a}	2.88^{a}	2.97^{a}	3.03^{a}
Bored	1.97^{a}	2.06^{a}	2.02^{a}	1.96^{a}	1.98^{a}
Calm	3.17^{b}	3.21^{b}	3.19^{b}	3.24^{b}	3.55^{a}
Disgusted	1.76^{a}	1.78^{a}	1.80^{a}	1.88^{a}	1.78^{a}
Energetic	3.15^{a}	3.00^{a}	2.99^{a}	3.10^{a}	3.26^{a}
Friendly	3.42^{ab}	3.35^{b}	3.35^{b}	3.45^{ab}	3.65^{a}
Good	3.74^{b}	3.78^{b}	3.70^{b}	3.81^{b}	4.05^{a}
Guilty	1.67^{b}	1.81^{ab}	1.85^{ab}	1.92^{a}	1.84^{ab}
Happy	3.48^{b}	3.52^{b}	3.43^{b}	3.58^{ab}	3.78^{a}
Interested	3.57^{abc}	3.53^{bc}	3.43^{c}	3.70^{ab}	3.81^{a}
Loving	3.01^{a}	3.06^{a}	3.03^{a}	3.12^{a}	3.29^{a}
Nostalgic	2.63^{a}	2.70^{a}	2.70^{a}	2.74^{a}	2.88^{a}
Peaceful	3.21^{a}	3.23^{a}	3.17^{a}	3.27^{a}	3.43^{a}
Satisfied	3.67^{b}	3.64^{b}	3.64^{b}	3.75^{ab}	3.97^{a}
Safe	3.79^{ab}	3.68^{b}	3.63^{b}	3.75^{b}	4.00^{a}
Steady	3.30^{a}	3.29^{a}	3.24^{a}	3.27^{a}	3.43^{a}
Warm	3.23^{a}	3.20^{a}	3.13^{a}	3.12^{a}	3.40^{a}
Whole	3.50^{a}	3.44^{a}	3.39^{a}	3.45^{a}	3.62^{a}
Worried	1.88^{a}	1.89^{a}	1.90^{a}	1.92^{a}	1.86^{a}
Acceptability	6.94^{bc}	6.98^{bc}	6.84^{c}	7.23^{b}	7.65^{a}

[a-c] Means with different superscripts within a row indicate significant differences (P < 0.05; ANOVA). Values are based on a 5-point rating scale (1 = not at all and 5 = extremely) for emotions and a 9-point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely) for acceptability.

[†]Egg quality attributes: Intrinsic = nutrient-fortified, organic, USDA-certified; Aesthetic = shell color, spotless eggshell, egg shape; Extrinsic = shell cleanness, thickness, surface smoothness, glossiness; Expedient = packaging type, sale price, egg size, product brand, egg grade, availability; Wholesome = freshness, 'packing/best-before-date', absence of visible cracks.

Table 4.2 Emotion intensities elicited by the absence of various egg quality attributes[†] (N = 320)

Emotions	Intrinsic	Aesthetic	Extrinsic	Expedient	Wholesome
Active	2.60[a]	2.60[a]	2.24[b]	2.20[b]	2.10[b]
Adventurous	2.52[ab]	2.63[a]	2.26[bc]	2.17[c]	2.18[c]
Bored	2.28[a]	2.12[a]	2.23[a]	2.41[a]	2.37[a]
Calm	2.79[a]	2.80[a]	2.33[b]	2.28[b]	2.06[b]
Disgusted	2.41[c]	2.31[c]	2.92[ab]	2.80[b]	3.22[a]
Energetic	2.66[a]	2.66[a]	2.27[b]	2.23[b]	2.21[b]
Friendly	2.82[a]	2.83[a]	2.33[b]	2.23[b]	2.08[b]
Good	3.00[a]	3.02[a]	2.41[b]	2.27[bc]	2.07[c]
Guilty	2.27[ab]	2.05[b]	2.24[ab]	2.29[ab]	2.46[a]
Happy	2.76[a]	2.90[a]	2.31[b]	2.20[b]	2.06[b]
Interested	2.75[a]	2.96[a]	2.43[b]	2.28[bc]	2.12[c]
Loving	2.54[ab]	2.67[a]	2.28[bc]	2.13[c]	2.04[c]
Nostalgic	2.43[ab]	2.59[a]	2.24[bc]	2.16[bc]	2.10[c]
Peaceful	2.71[a]	2.80[a]	2.34[b]	2.24[b]	2.07[b]
Satisfied	2.94[a]	2.94[a]	2.29[b]	2.22[b]	2.01[b]
Safe	2.94[a]	3.05[a]	2.39[b]	2.39[b]	2.06[c]
Steady	2.81[a]	2.85[a]	2.34[b]	2.24[b]	2.07[b]
Warm	2.70[a]	2.81[a]	2.34[b]	2.24[b]	2.09[b]
Whole	2.90[a]	2.96[a]	2.39[b]	2.33[b]	2.09[b]
Worried	2.38[c]	2.27[c]	2.77[b]	2.84[b]	3.29[a]
Acceptability	5.05[a]	5.27[a]	4.05[b]	3.81[bc]	3.41[c]

[a-c] Means with different superscripts within a row indicate significant differences ($P < 0.05$; ANOVA). Values are based on a 5-point rating scale (1 = not at all and 5 = extremely) for emotions and a 9-point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely) for acceptability.

[†] See Table 4.1 for attribute description [Intrinsic, Aesthetic, Extrinsic, Expedient and Wholesome].

For absence of egg attributes, none of the emotions had intensity ratings higher than 3.5 for all egg quality attributes (Table 4.2). Negative emotions were generally more dominant with the lack of wholesome, expedient and extrinsic attributes than with intrinsic and aesthetic attributes (Table 4.2). Specifically, disgusted and worried were higher ($P < 0.05$) for absence of wholesome, expedient and extrinsic than for intrinsic and aesthetic attributes; and their mean intensities ranged from 2.77 (extrinsic; worried) to 3.29 (wholesome; worried). Emotion intensities for intrinsic and aesthetic attributes ranged from 2.90 (intrinsic; whole) to 3.02 (aesthetic; good), with good and safe having the two highest emotion intensities. For emotions with intensity ratings ≥ 2.8 across absence of egg quality attributes, the number of emotions were 11 (aesthetic; calm, friendly, good, happy, interested, peaceful, satisfied, safe, steady, warm, whole) *vs.* 9 (intrinsic; calm, friendly, good, happy, interested, satisfied, safe, steady, whole) *vs.* 2 (extrinsic; disgusted, worried) *vs.* 2 (expedient; disgusted, worried) *vs.* 2 (wholesome; disgusted, worried) (Table 4.2).

In summary, the presence and absence of expedient and wholesome attributes generally elicited stronger positive and negative emotions, respectively, compared to intrinsic, aesthetic and extrinsic characteristics (Tables 4.1 and 4.2).

4.3.2 Emotions differentiating egg products with different quality attributes

For the current study sample, an overall difference existed in the emotions elicited by 10 egg quality attributes (5 types of egg attributes * presence/absence, $P < 0.0001$), considering all emotion terms simultaneously from MANOVA (Table 4.3). Descriptive Discriminant Analysis (DDA) revealed 11 discriminating emotions underlying quality differences both in their presence and absence as good, satisfied, safe, happy, interested, friendly, whole, disgusted, calm, steady,

and worried from the first dimension (Can 1) of the linear discriminant functions which accounted for 88% of the variance (Table 4.3). According to Rousset and others (2005), disgust, to like, pleasure, guilt, uneasiness, vigilant, content, doubt, satisfaction and delight were the emotions that best discriminated pictures of 30 food items by 60 women.

MANOVA analysis showed significant differences among egg quality attributes when present ($P < 0.0255$) and absent ($P < 0.0001$). DDA revealed 7 emotions differentiating among egg quality attributes when present *vs.* 12 emotions when absent. Emotions in decreasing order of discrimination as seen from Can 1 were calm, good, interested, satisfied, safe, happy and active for attribute presence compared to good, satisfied, safe, whole, worried, steady, happy, friendly, calm, disgusted and interested for attribute absence (Table 4.3). Since the magnitude of the canonical correlation for these discriminating emotions (except calm and interested) was higher for absence than presence, consumer emotions associated with eggs may be due more to the former than the latter.

Significant differences were observed in the extent to which emotions found to have high discriminatory ability from DDA were elicited by the various egg attributes (Table 4.4). For attribute presence, safe, satisfied, interested, happy and good emotions were elicited to a significantly higher extent ($P < 0.05$) than the other emotions by only aesthetic and expedient attributes. For attribute absence nonetheless, disgusted and worried were significantly higher than the other emotions for only wholesome and expedient attributes, but were not significantly different among themselves. However, for intrinsic and aesthetic quality, disgusted and worried emotions were not elicited to significantly different extents ($P \geq 0.05$), but were significantly lower ($P < 0.05$) than the other emotions, with the exception of peaceful and disgusted which were the same for intrinsic attributes.

Table 4.3 The pooled within canonical structure (*r's*)* describing emotions that underlie group differences for egg attributes

Emotions	All**		Presence**		Absence**	
	Can 1***	Can 2***	Can 1***	Can 2***	Can 1***	Can 2***
Active	0.478	-0.330	*0.530*	-0.300	0.382	0.005
Adventurous	0.329	-0.076	0.228	0.054	0.316	0.133
Bored	-0.164	0.140	-0.077	0.037	-0.126	-0.285
Calm	*0.517*	0.039	*0.586*	0.032	*0.560*	0.066
Disgusted	*-0.555*	-0.209	0.017	0.169	*-0.555*	-0.097
Energetic	0.393	-0.139	0.335	-0.209	0.365	-0.045
Friendly	*0.575*	-0.065	0.440	-0.071	*0.561*	0.059
Good	*0.789*	-0.073	*0.582*	-0.043	*0.701*	0.093
Guilty	-0.252	0.138	0.118	0.401	-0.179	-0.337
Happy	*0.654*	-0.183	*0.543*	-0.004	*0.569*	0.207
Interested	*0.647*	-0.323	*0.558*	-0.070	*0.534*	0.331
Loving	0.429	-0.107	0.381	0.064	0.413	0.234
Nostalgic	0.254	0.019	0.301	0.129	0.309	0.227
Peaceful	0.486	-0.029	0.362	-0.022	*0.500*	0.168
Satisfied	*0.756*	-0.051	*0.548*	-0.002	*0.690*	0.022
Safe	*0.743*	-0.123	*0.545*	-0.261	*0.678*	0.169
Steady	*0.507*	0.111	0.232	-0.111	*0.572*	0.107
Warm	0.455	-0.014	0.317	-0.225	0.488	0.186
Whole	*0.565*	0.073	0.279	-0.168	*0.615*	0.108
Worried	*-0.501*	-0.302	-0.048	0.074	*-0.604*	-0.270
% variance explained	87.72	3.71	44.67	32.42	76.44	13.64

*Based on the pooled within group variances with $P < 0.0001$ for both presence and absence of attributes, $P < 0.0255$ for presence of attributes and $P < 0.0001$ (absence) of Wilks' Lambda from MANOVA. Italicized values indicate attributes largely contributing to the overall differences among all egg samples. Cut-off canonical coefficient value: $\geq \pm 0.5$

**See Table 4.1 for attribute description [Intrinsic, Aesthetic, Extrinsic, Expedient and Wholesome].

***Can 1 and Can 2 refer to the pooled within canonical structure in the first and second canonical discriminant functions, respectively.

Table 4.4 Attribute effects on emotions discriminating among eggs with different quality[†] (N = 320)

Emotions*	Presence[†]					Absence[†]				
	Intrinsic	Aesthetic	Extrinsic	Expedient	Wholesome	Intrinsic	Aesthetic	Extrinsic	Expedient	Wholesome
Active	3.23^{cd}	3.14^{b}	2.97^{c}	3.20^{b}	3.43^{c}	-	-	-	-	-
Calm	3.17^{d}	3.21^{b}	3.19^{bc}	3.24^{b}	3.55^{bc}	2.79^{a}	2.80^{a}	2.33^{c}	2.28^{b}	2.06^{b}
Disgusted	- [e]	-	-	-	-	2.41^{bc}	2.31^{b}	2.92^{a}	2.80^{a}	3.22^{a}
Friendly	-	-	-	-	-	2.82^{a}	2.83^{a}	2.33^{c}	2.23^{b}	2.08^{b}
Good	3.74^{ab}	3.78^{a}	3.70^{a}	3.81^{a}	4.05^{a}	3.00^{a}	3.02^{a}	2.41^{bc}	2.27^{b}	2.07^{b}
Happy	3.48^{bc}	3.52^{a}	3.43^{ab}	3.58^{a}	3.78^{ab}	2.76^{ab}	2.90^{a}	2.31^{c}	2.20^{b}	2.06^{b}
Interested	3.57^{ab}	3.53^{a}	3.43^{ab}	3.70^{a}	3.81^{ab}	2.75^{ab}	2.96^{a}	2.43^{bc}	2.28^{b}	2.12^{b}
Peaceful	-	-	-	-	-	2.71^{abc}	2.80^{a}	2.34^{c}	2.24^{b}	2.07^{b}
Satisfied	3.67^{ab}	3.64^{a}	3.64^{a}	3.75^{a}	3.97^{a}	2.94^{a}	2.94^{a}	2.29^{c}	2.22^{b}	2.01^{b}
Safe	3.79^{a}	3.68^{a}	3.63^{a}	3.75^{a}	4.00^{a}	2.94^{a}	3.05^{a}	2.39^{c}	2.39^{b}	2.06^{b}
Steady	-	-	-	-	-	2.81^{a}	2.85^{a}	2.34^{c}	2.24^{b}	2.07^{b}
Whole	-	-	-	-	-	2.90^{a}	2.96^{a}	2.39^{c}	2.33^{b}	2.09^{b}
Worried	-	-	-	-	-	2.38^{c}	2.27^{b}	2.77^{ab}	2.84^{a}	3.29^{a}

[*] Emotions differentiating eggs with different quality as obtained from Descriptive Discriminant Analysis (Table 4.3).

[a-d] Means with different superscripts within a column indicate significant differences ($P < 0.05$; ANOVA).

[†] See Table 4.1 for attribute description [Intrinsic, Aesthetic, Extrinsic, Expedient and Wholesome].

[e] Emotions did not differentiate among egg products for attribute presence or absence based on Descriptive Discriminant Analysis (Table 4.3).

From the PCA, PC1 and PC2 accounted for 66.10% and 76.83% of the total variance for attribute presence and absence, respectively (Figure 4.3A and 4.3B). The PCA biplots showed 4 egg attribute groupings of egg samples with slightly different emotional profile for presence: Wholesome, Expedient, Intrinsic and Extrinsic–Aesthetic; and 2 attribute groupings for absence: Intrinsic–Aesthetic and Wholesome–Expedient–Extrinsic. For both attribute presence and absence, emotions with a negative connotation were uncorrelated with positive emotions, particularly for those underlying differences among products as seen from DDA (Table 4.3).

Overall, results from DDA, ANOVA and PCA identified that, the critical emotions differentiating eggs with these 5 quality attributes in decreasing order of importance were good, satisfied, safe, happy and interested (Table 4.3 and Figure 4.3).

4.3.3 Consumer acceptability of eggs with different quality attributes

Acceptability has been found to correlate sometimes with emotions and sometimes does not, based on the product, product category, demographics and psychographics (King and Meiselman 2010; Porcherot and others 2010). In this study, effects of attribute presence and absence on acceptability rating of eggs was significant ($P < 0.05$; a t-test), with liking being consistently higher for presence than absence of attributes (Figure 4.4). Presence of egg quality attributes resulted in eggs that were mostly liked by consumers with mean liking scores ranging from 6.84 (extrinsic) to 7.65 (wholesome), while absence of attributes led to product dislike or neutral liking with scores ranging from 3.41 (wholesome) to 5.27 (aesthetic) for attribute absence (Tables 4.1 and 4.2).

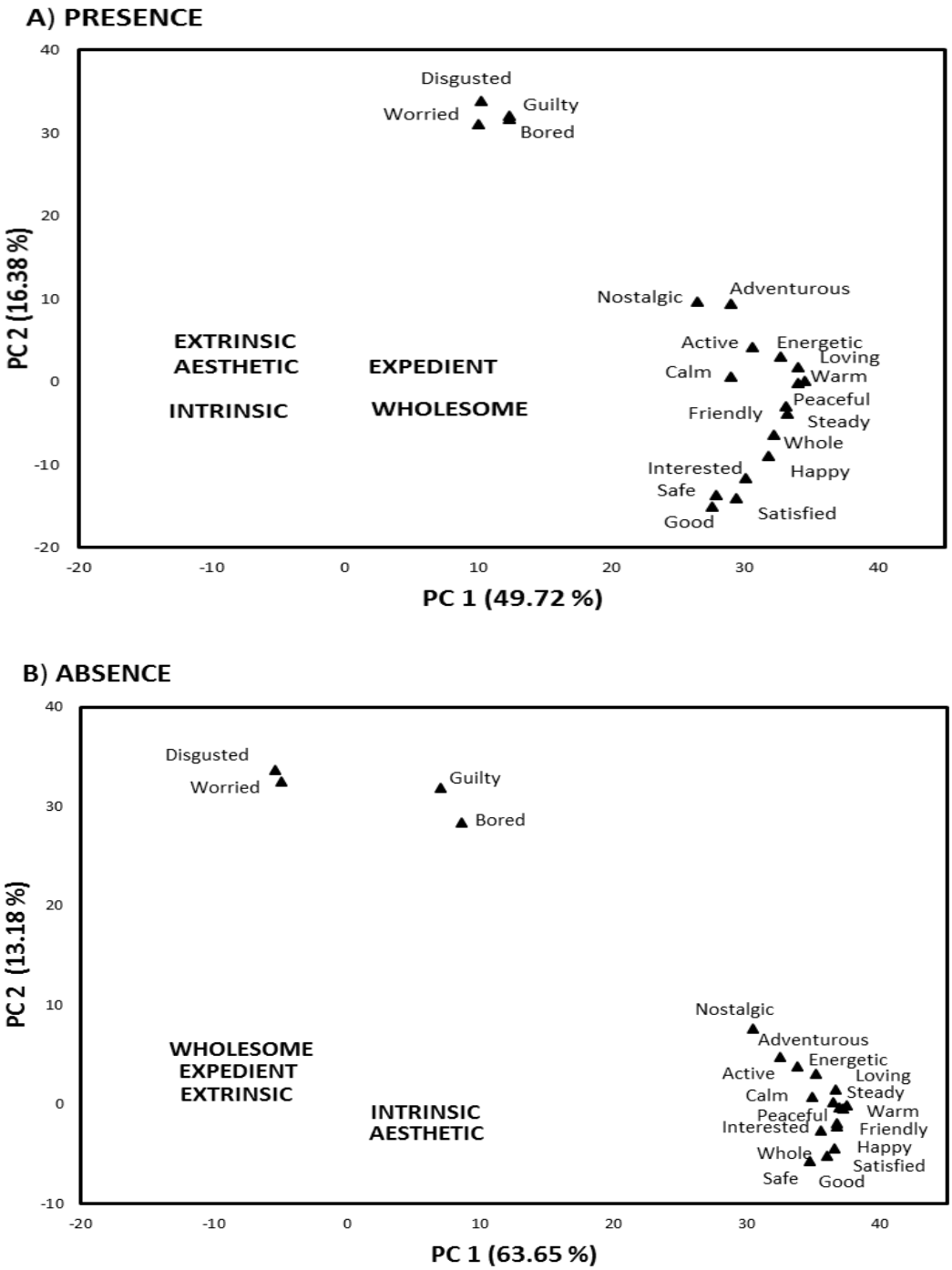

Figure 4.3 PCA bi-plots of the emotional profile of eggs in the A) presence and B) absence of different egg quality attributes. The accumulated variance explained by principal component 1 and principal component 2 was 66.10% and 76.83% for presence and absence, respectively. See the footnote of Table 4.1 for attribute description [Intrinsic, Aesthetic, Extrinsic, Expedient and Wholesome].

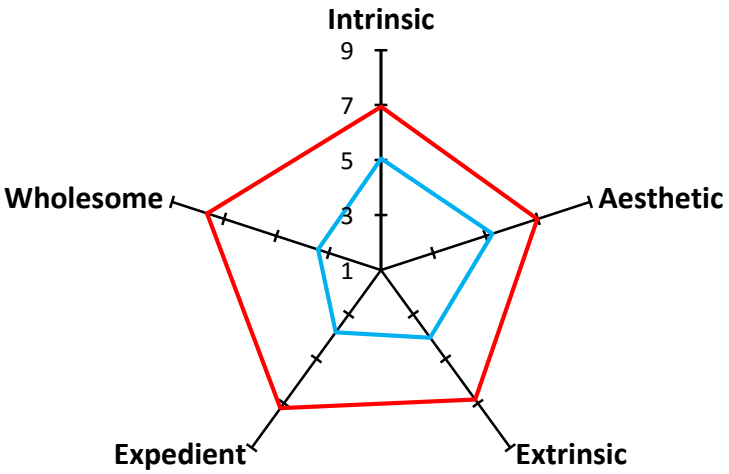

Figure 4.4 Effects of attribute presence and absence on acceptability (1 = dislike extremely; 9 = like extremely) of eggs with different quality (N = 320). (▬) = presence; (▬) = absence of egg quality attributes. Acceptability of egg attributes were significantly different ($P < 0.05$; a t-test) for attribute presence vs. absence. See the footnote of Table 4.1 for attribute description [Intrinsic, Aesthetic, Extrinsic, Expedient and Wholesome].

Generally, presence of expedient and wholesome attributes was concomitant to higher acceptance scores than the other quality groupings (Table 4.1). However, acceptability of eggs with either intrinsic or aesthetic qualities was similar to those having expedient and/or aesthetic elements ($P \geq 0.05$). Distinctly, wholesome attributes resulted in significantly higher ($P < 0.05$) acceptability than that of all other attributes (Table 4.1). On the other hand, absence of aesthetic and intrinsic attributes did not negatively affect consumer acceptability compared to the lack of expedient and wholesome characteristics (Table 4.3). However, eggs lacking expedient quality were disliked similarly to those lacking either extrinsic or wholesome quality ($P \geq 0.05$, Table 4.2). Hence, as seen from Tables 4.1 and 4.2, it is evident that, wholesome and expedient attributes had the most influence on consumer acceptability of eggs.

Correlations between product acceptability and emotions were observed in this study (Table 4.5). Results showed a larger magnitude of correlation between acceptability and emotions for attribute absence than for its presence. The strongest correlations were detected for unwholesome eggs. Furthermore, good, happy and satisfied were the only emotions with a correlation coefficient ≥ 0.6 for all quality attributes, and thus were strongly related to egg acceptability. These findings reflect the assertion made by Manzocco and others (2013) that, rational consideration of product quality characteristics along with the food associated affective state may be the drivers of acceptability responses by consumers.

4.4 Discussion

Evaluating emotional responses in the presence and absence of critical product attributes in addition to sensory characteristics, may throw more light on the conceptualizations affecting consumers purchase decision and satisfaction. In this study, the presence and absence of egg quality characteristics elicited both positive and negative emotions in consumers to varying extents. While eggs with or without wholesome and expedient quality induced distinct emotions compared to other attributes, the degree of change in positive emotions associated with eggs lacking intrinsic and aesthetic attributes was not as marked. Collectively, the emotional profile of eggs was defined by the emotions: good, satisfied, and safe, in addition to 'other' emotions that differentiated between different quality groupings.

Table 4.5 Pearson correlation coefficients (r)[a] between emotion and acceptability ratings for eggs with different attributes [†]

Emotions	Intrinsic		Aesthetic		Extrinsic		Expedient		Wholesome	
	Presence	Absence	Presence	Absence	Presence	Absence	Presence	Absence	Presence	Absence
Active	0.357	0.481	0.295	0.540	0.274	0.645	0.326	0.659	0.200	0.648
Adventurous	0.273	0.451	0.224	0.480	0.281	0.621	0.203	0.605	0.118	0.647
Bored	-0.217	0.002*	-0.208	-0.040*	-0.106*	0.056*	-0.192	0.052*	-0.247	0.044*
Calm	0.163	0.496	0.294	0.554	0.301	0.618	0.355	0.632	0.223	0.729
Disgusted	-0.192	-0.330	-0.142	-0.301	-0.129	-0.344	-0.287	-0.197	-0.242	-0.313
Energetic	0.243	0.447	0.281	0.521	0.307	0.631	0.255	0.626	0.212	0.656
Friendly	0.234	0.581	0.312	0.585	0.372	0.673	0.381	0.689	0.300	0.733
Good	0.302	0.653	0.489	0.603	0.524	0.726	0.591	0.680	0.463	0.783
Guilty	-0.103	-0.120	-0.054*	-0.108*	-0.065*	0.062*	-0.198	0.064*	-0.243	0.013*
Happy	0.359	0.633	0.365	0.604	0.428	0.652	0.507	0.671	0.404	0.799
Interested	0.314	0.567	0.396	0.610	0.479	0.676	0.515	0.658	0.393	0.734
Loving	0.288	0.546	0.282	0.500	0.319	0.703	0.274	0.674	0.228	0.763
Nostalgic	0.178	0.370	0.177	0.458	0.192	0.526	0.191	0.513	0.086*	0.584
Peaceful	0.288	0.580	0.345	0.543	0.325	0.679	0.346	0.633	0.255	0.735
Satisfied	0.348	0.662	0.445	0.641	0.518	0.701	0.581	0.679	0.436	0.761
Safe	0.386	0.665	0.463	0.595	0.411	0.666	0.575	0.634	0.464	0.735
Steady	0.242	0.595	0.347	0.503	0.369	0.668	0.361	0.639	0.270	0.720
Warm	0.219	0.567	0.251	0.497	0.341	0.724	0.277	0.688	0.208	0.756
Whole	0.272	0.624	0.372	0.560	0.417	0.711	0.396	0.644	0.255	0.758
Worried	-0.127	-0.272	-0.141	-0.249	-0.153	-0.252	-0.253	-0.224	-0.251	-0.345

[†] See Table 4.1 for details.

[a] For the null hypothesis (Ho): r = zero.

* Correlations are not statistically significant ($P \geq 0.05$).

Aesthetic and extrinsic features are constituted by visual sensory attributes directly appraised by the consumer at the point of purchase. Hence, emotional reaction can be explained as a reflection of consumer impressions of the product. Eggshell quality may be affected by factors including genetics, age of birds, nutrition and production system (Roberts 2004). In this study, aesthetic attributes such as desired color (white), egg shape and spotless eggshell resulted in 'other' emotions including interested and happy (Table 4.1). Consumers mostly expressed disgust at the lack of tangible extrinsic eggshell features like cleanness, thickness, surface smoothness and glossiness. Since screening of these features are essential egg processing steps, it must be warranted in order to pique consumer interest and minimize disgust. Studies by Manzocco and others (2013) on emotional responses to fruit salads with different visual quality reported the most frequently experienced emotions as relaxed, calm, quiet, peaceful and friendly, with the latter three showing a decrease in usage frequency with spoilage.

Intrinsic variables relating to enhanced nutrient content (e.g., omega-3 and folate), organic and USDA-certified farm eggs were associated with key 'other' emotions: whole, active, warm and steady. However, compared to other egg quality groupings, their absence elicited slightly higher intensities of the positive emotions. This is because, intrinsic emotions possibly arise from either experienced or anticipated consequences (Desmet and Schifferstein 2008) consumers ascribe to eggs with these qualities. Intrinsic quality may tend to echo superior and desirable egg qualities, particularly, optimum nutrition for some consumers with certain needs, but for others, it may represent a superfluous requirement. Dynamic effects of intrinsic and, to a lesser extent, aesthetic and extrinsic attributes on emotions probably indicates the existence of divergent consumer groupings with differing attitudes and expectations. Hence, further studies to identify distinct consumer segments with different preferences and emotional profile would be necessary.

Wholesome and expedient characteristics seemed essential as they generated positive and negative emotions with the highest intensities, particularly good, safe, disgusted and worried. This suggests that, safety concerns of eggs were considered critical to product acceptance. Expedient features such as egg grade and weight/size, which constitute important aspects of US standards of grading for shell eggs (USDA 2000), were vital as well since their presence indicates a high convenience value for the product. According to Jibir and others (2012), consumer preference is often for large and extra-large eggs, and a large egg size was found to engender good, satisfied, safe, interested and happy emotions in consumers (Table 4.1).

Acceptability and emotion scores can yield different conclusions about products and differences among products (King and others 2013). Relationships between acceptability and emotions were observed in this study. Eggs with wholesome attributes were most liked and distinctly different from other egg attributes by the emotions good, safe and calm. However for expedient, aesthetic and intrinsic attributes which did not differ in liking, guilty was the only emotion that differed. On the other hand, unwholesome eggs were most disliked and clearly different from the other attributes in the emotions safe, disgust and worried. It is realized that, by no means are all emotions studied here representative of the emotional impact of eggs on consumers; and results are associated only to the eliciting conditions. However, since it is based on the soundness of the EsSense® Profile (King and Meiselman 2010), it is the belief of the authors that findings gleaned from this study provides useful information to the egg industry, especially for those emotions that were found to characterize eggs with different characteristics. Since there appears to be a market niche especially for eggs with intrinsic quality, further studies on the effects of demographics may yield additional beneficial information. Also, future work

quantifying the effects of attribute presence and absence on emotions associated with food products along with sensory data may prove valuable for product developers.

4.5 Conclusions

This study demonstrated that, the degree to which consumer emotional responses vary in the presence *vs.* absence of product quality attributes can influence inferences about importance of attributes of interest. In this illustration, emotion ratings along with hedonic testing revealed significant differences between the emotional profile of highly acceptable wholesome eggs and less acceptable egg products; hence eggs with different quality attributes could be differentiated by emotional data. Further, the benefit of highly rated positive emotions identified for wholesome and expedient attributes, was distinct from the comparative emotional response to the presence and absence of intrinsic, aesthetic, and extrinsic attributes, which could not be clearly differentiated indicating the relative importance of the former to consumer acceptance than the latter. This study is advantageous to product developers and the egg industry, as it identifies opportunities to better understand consumer needs, thereby, designing products destined for success in the marketplace.

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CHAPTER 5.
ATTRIBUTE PERFORMANCE ON SATISFACTION AND EMOTIONS AS PREDICTORS OF PRODUCT ACCEPTABILITY

5.1 Introduction

At the heart of the development of new products is determining what consumers want so new features and sensory attributes can be incorporated to create differentiation for the product and brand. The goal of the process is measurable on several affective indices including acceptability/liking, a differentiating emotional profile and/or an increase in satisfaction. The framework of consumer food choice can therefore be considered in terms of quality expectations prior to and quality experiences after the purchase (Grunert 2002). However to understand the impact a product has on consumer acceptance, the emotional experience and decision making process a consumer has with that product must also be understood together with information about packaging/pricing and sensory attributes (Li and others 2015).

Consumer acceptance, emotions and satisfaction often tap into the same dimensions of consumer behavior, however they may each measure very different things and have conventionally been considered as distinct constructs of consumer preferences (Cardello 2000; Mielby and others 2016). Acceptance has been widely used in consumer studies to capture average food liking or disliking considered critical to understanding relationships between the chemical senses and varying levels of food preferences, as well as predicting food behavior and selection (Peryam and pilgrim 1957; Lim and others 2009). Consumers' acceptability ratings of a product are therefore utilized as a sensory benchmark in the product development process to characterize consumer attitudes and purchase decision. While considered an indispensable and valid quantitative measure of hedonic perception, it falls short in consistently forecasting market

success and discriminating food products with similar sensory properties (Jiang and others 2014).

Satisfaction has been characterized as a key mediator in determining generalized outcomes of the consumption experience including consumer post-purchase behavior and loyalty (Mano and Oliver 1993; Westbrook and Oliver 1991; Cardello and others 2000). This implies that in relation to food choice and consumption, satisfaction plays a central role when it comes to repeated choice and purchase behavior. Notwithstanding this widely appraised comprehension of satisfaction as mainly a post-consumption appraisal (Mojet 2011; Cardello and others 2000), Andersen and Hyldig (2015a, 2015b) recently demonstrated that, while sensory experience was found to be a primary determinant of food satisfaction, it is influenced by multiple factors including consumer's expectations, desire for sensory variation and a feeling of wellbeing. Indeed, consumer satisfaction is a composite accruing from interactions with multifaceted aspects of a product, however in the domain of sensory science, sensory and food satisfaction may be of the greater interest. The confirmation/disconfirmation of expectations prior to, during, and after consumption has been found to be a critical factor influencing food satisfaction (Andersen and Hyldig 2015b). In understanding consumer expectations, the Kano model provides a valuable tool to the product developer to assess the relationships between attribute performance, and its impact on consumer satisfaction and dissatisfaction from the consumers' perspective (Kano and others 1984; Matzler and others 1996). In the Kano Model, two dimensional relationships of the effects of attribute fulfillment and nonfulfillment on consumer satisfaction and dissatisfaction are assessed based on consumer expectations. Product attributes can be classified as having a linear relationship with satisfaction (one-dimensional), influencing dissatisfaction only (must-be or basic), enhancing satisfaction only (attractive), having no effect

on satisfaction (indifferent) and reverse and/or questionable effects (Kano and others 1984). The Kano model therefore provides valuable information in trade-off situations during new product development and quality improvement processes where identifying and prioritizing attributes contributing to consumers' satisfaction and dissatisfaction with products may create the possibility for differentiation from competitors.

The many parts of emotions elicited by food products (valence, arousal, dominance) have recently been of major interest to sensory scientists to characterize differences in similar products that might help better understand the food affective space and actual food choice. Emotions have been found to successfully discriminate between products with high acceptability without providing redundant information (King and Meiselmann 2010; Ng and others 2013). Generally, positive emotions such as enthusiastic, friendly, glad, good, good-natured, happy, joyful, pleased, and satisfied are significantly correlated with liking while negative emotions such as disgusted and guilty are adversely correlated with liking (Cardello and others 2012). However for some foods such as chocolate and pizza, emotions may be at variance as they are often defined by terms such as guilty-pleasure, and liking scores may not be predicted by positive emotions. Ng and others (2013) found high correlations between liking and unclassified emotions such as eager, polite, steady and understanding in blackcurrant squash product. It is possible that differences in consumer expectations may explain such inconsistent associations between emotion and liking (Jiang and others 2014).

In attempting to understand the constructs between food emotions and acceptability, no distinction between emotions characterizing attributes impacting satisfaction in dissimilar ways has been made. Nonetheless, an understanding of hedonic liking by assessing the dynamics of emotional characteristics and satisfaction dimensions of food products may have significant

consequences for optimizing product design to enhance profits. One would expect that, even though positive emotions and hedonic responses may be linked with the fulfillment of must-be Kano attributes, their sensory-emotion profile could be different from that of attractive attributes which have a delightful "surprise" element. On the other hand, it may be less clear-cut to predict whether the emotions associated with one-dimensional and indifferent attributes will be direct polar opposites in their presence *vs.* absence. This study argues that, while it may be logical and worthwhile to predict consumer satisfaction from emotions and acceptability, it is envisaged that, in the product development process, modeling acceptability from attribute performance on satisfaction and their emotional connotations may be of greater benefit as it provides the developer with a decision-making tool in tradeoff situations, and may result in more insightful characterization of the sensory-emotional profile of foods. At the present, the underlying relationships among food-evoked emotions, acceptability and satisfaction as assessed by Kano modeling concepts has not been reported in the literature to the best of our knowledge. Hence the purpose of this work was to first explore the association between Kano categories of consumer satisfaction and emotions. Next, consumer liking is predicted from emotions and Kano satisfaction categories to enhance understanding of the factors influencing the affective space of foods.

5.2 Materials and Methods

5.2.1 Participants and stimuli

To examine the research questions of the present study, we integrated existing data sets from the two preceding chapters (Wardy and others 2014, 2015) to link emotions to consumer satisfaction, and explore their contribution to liking. In this approach therefore, multifaceted

quality features of a product were studied for their impact on consumer satisfaction as assessed by the Kano model, emotions (decomposed into their valence components) and liking scores in their fulfillment and nonfulfillment conditions, using eggs as a food model.

The study sample comprised of 320 randomly selected consumers screened for age (≥ 18 years), egg purchase and consumption. Stimuli consisted of the 5 types of egg quality attributes differentiated on the basis of their importance to purchase intent (Wardy and others 2014). Egg attribute groupings comprised intrinsic (nutrient-fortified, organic, USDA-certified), aesthetic (shell color, spotless eggshell, egg shape), extrinsic (shell cleanness, thickness, surface smoothness, glossiness), expedient (packaging type, sale price, egg size, product brand, egg grade, availability), and wholesome (freshness, 'packing/best-before-date', absence of visible cracks) attributes.

5.2.2 Consumer affective measures

The classic Kano method was adopted for Kano classification of egg quality variables involving consumer evaluation of benefit statements. For the evaluation of Kano attribute performance on satisfaction, consumer responses to 10 question pairs for attribute presence and absence were utilized. For example, how would you feel if the egg is organic *vs*. how would you feel if the egg is inorganic? Egg attributes were classified into five requirement types: "must-be" - if the product does not have this, no one will be interested in it; "one-dimensional" - the more you provide this function, the more satisfied the consumer will be; "attractive/delighters" - consumer is happy when it is there, but will not complain if it is not there; "indifferent" - the customer does not care about this feature; or "reverse/questionable" – confusing question or this attribute has a negative interaction with other critical features. Frequencies for Kano categories

were aggregated for each egg quality grouping along with their satisfaction and dissatisfaction coefficients.

The emotional profiles of the 5 types of egg quality attributes were determined in the presence *vs*. absence conditions. Emotions included positive (active, adventurous, calm, energetic, friendly, good, happy, interested, loving, peaceful, satisfied, safe, steady, warm, whole), neither positive nor negative (nostalgia), and negative (bored, disgusted, worry, guilty) terms (Jiang and others 2014). Overall acceptability for each quality grouping was measured using a 9-point hedonic category scale (1 = dislike extremely, 5 = neither dislike nor like, 9 = like extremely; Peryam and Pilgrim 1957), and emotion intensities were rated on a 5-point scale using the verbal self-report EsSense Profile® questionnaire (1 = not at all; 2 = slightly; 3 = moderately; 4 = very; 5 = extremely; King and Meiselman 2010).

5.2.3 Statistical analyses

Qualitative and quantitative data from 3 types of affective responses (Kano frequencies/satisfaction coefficients, emotion and liking ratings) to the egg commodity were collated on Microsoft Excel® spreadsheets. Emotions were decomposed into positive and negative valence consisting of 16 and 4 terms respectively from the EsSense Profile® for the measurement of food-evoked emotions (King and Meiselman 2010). To obtain consensus product maps and elucidate relative associations between Kano attribute performance on satisfaction and emotion scores, a series of multiple factor analysis (MFA) were applied to the data separately for attribute fulfillment and nonfulfillment conditions. An overview of the MFA data matrix consisted of averaged data from the 4 Kano categories, emotion and liking scores for the observed 5 egg quality groupings. MFA analyzes several tables of variables describing the

same observations which differ in number and nature from one another (Moussaoui and Varela 2010). For each table or group however, the variables must be of the same nature (quantitative or qualitative). 3 Kano classifications impacting satisfaction (must-be, attractive, one-dimensional) were considered in the MFA analysis. Indifferent Kano attributes, although having no impact on consumer satisfaction were considered as supplementary variables in the MFA analysis as some were identified as 'beneficial' based on their satisfaction and dissatisfaction coefficients (Wardy and others 2014), hence their emotional profile were of interest. Most of the important variation in the data sets was captured by the first two dimensions of the MFA biplots. In addition to this, a measure of the degree of similarity between the consensus product spaces derived from the affective measures was given by the regression vector (R_V) coefficient (Schlich 1996). R_V values are between 0 and 1, the closer to 1, the more similar are the measures.

The probability (odds) of overall product acceptability (liked *vs*. disliked) was predicted using logistic regression analysis (LRA) with emotions, Kano attributes and their interactions as explanatory variables. To mitigate effects of multicollinearity among explanatory variables, principal component analysis involving correlation matrices was performed on the emotion data, and factor scores from the first (positive emotions including nostalgia) and second (negative emotions) dimensions were used. Data from expedient egg attributes comprising of must-be, attractive, one-dimensional and indifferent Kano attributes were used for regression modeling, since all 4 Kano categories were distinctively represented. All data analyses were done at $\alpha = 0.05$ using the SAS software (SAS, version 9.4, 2003), with the exception of MFA which was conducted using the XLSTAT® add-in for Microsoft Excel (Addinsoft™, version 2015.6, NY, USA)

5.3 Results

5.3.1 Correspondence among constructs of satisfaction and emotions

As shown in Figure 5.1A, the structure on the observations of egg quality groupings induced by Kano attributes and positive emotions were very similar. It can be seen from the MFA product plots in Figure 5.2A how close these two constructs were for all quality categories, especially for eggs with extrinsic and aesthetic attributes based on their projected partial lines from their consensus positions. It can also be seen that the differences between negative emotions and Kano/positive emotions were greatest for intrinsic, expedient and wholesome egg attributes, with negative emotions being more defined by the second dimension compared to Kano and positive emotions, which were characterized by the first dimension (Figure 5.2A). These results are confirmed by the Rv coefficients between the constructs (Table 5.1). The Rv coefficient measures the correlation between two sets of variables which have been measured on the same samples (Escoufier and Robert 1976; Schlich 1996). For attribute presence, the Rv coefficient between Kano and positive emotions was 0.805 and 0.247 between Kano and negative emotions, reflecting smaller (similar structure) and bigger distances (different structure) between their partial points respectively. However for attribute absence, similarities were found between the structure of Kano attributes and either positive (0.758) or negative (0.810) emotions (Figures 5.1-B1 and 5.2-B1; Table 5.1). A similar trend was observed when satisfaction coefficients and emotion scores were compared (Figures 5.1-A2, B2 and 5.2-A2, B2; Table 5.1).

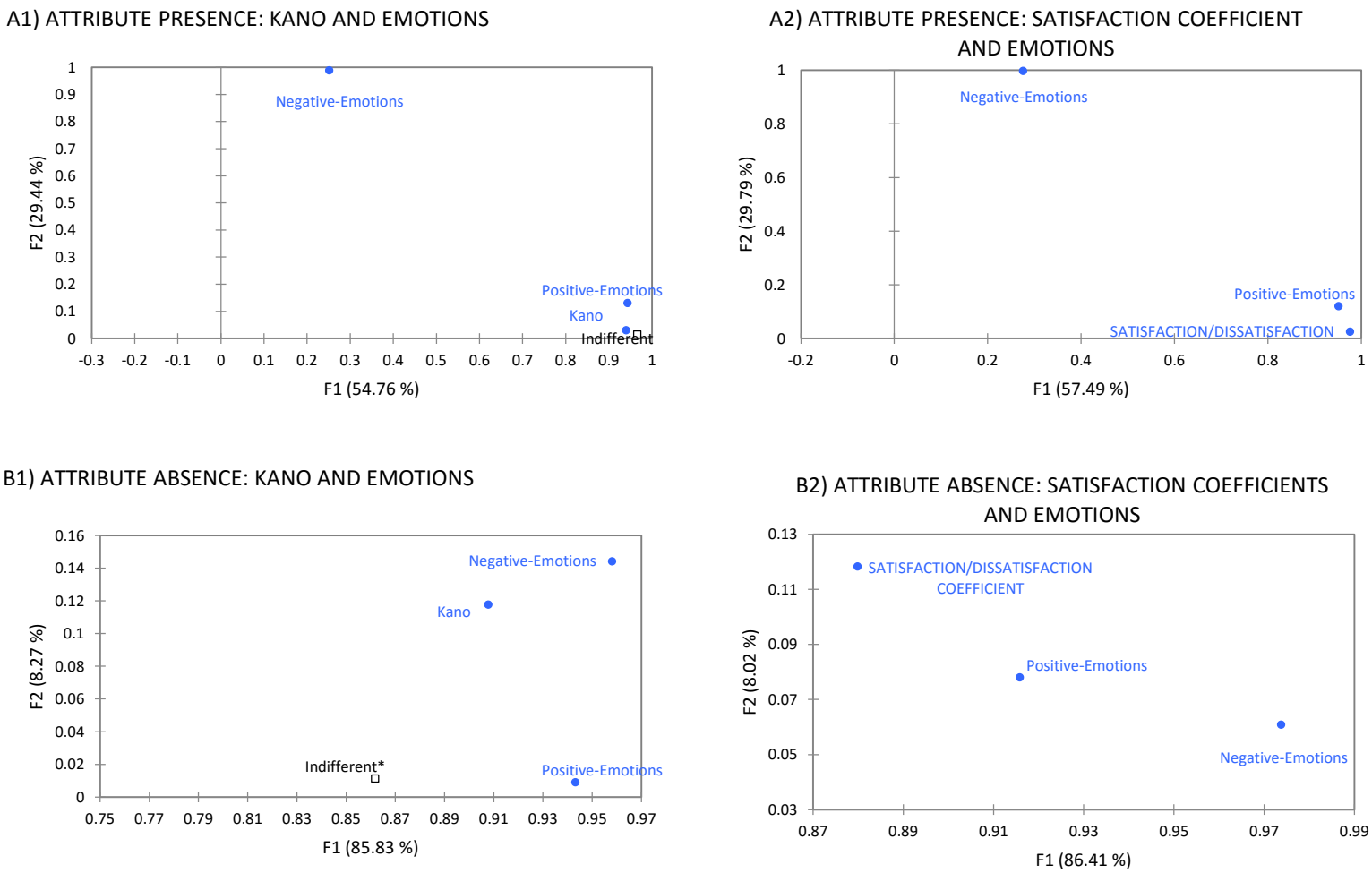
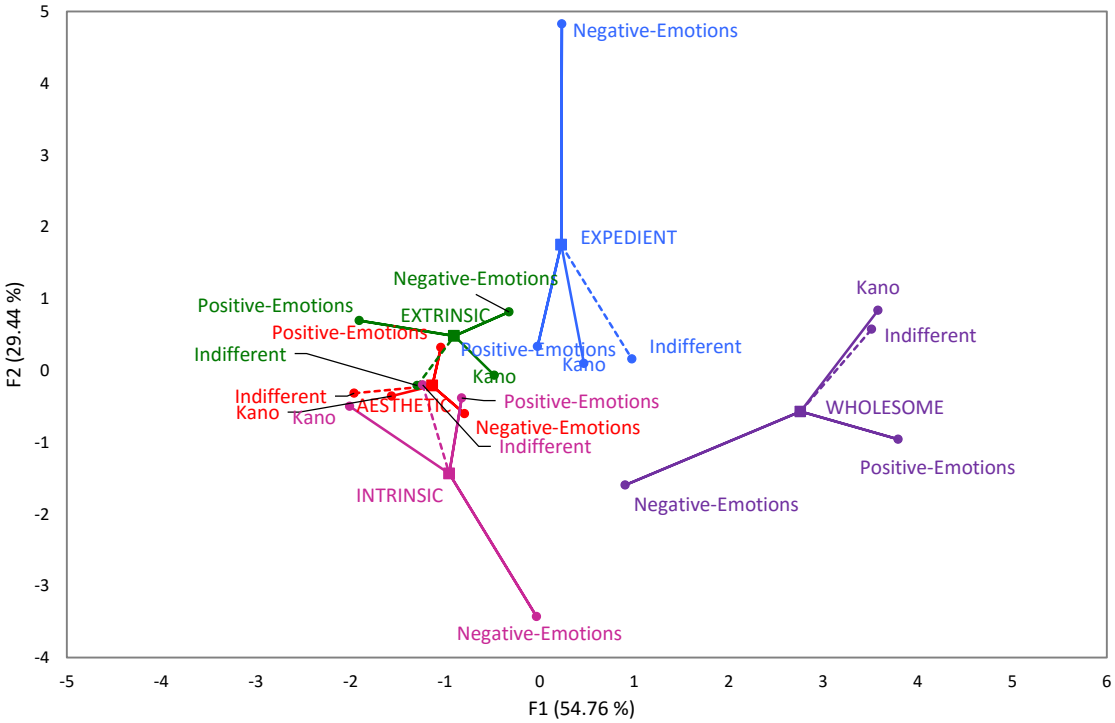


Figure 5.1 Representation of the groups of variables: positive emotions, negative emotions and satisfaction on the first and second dimensions of the MFA. * Indifferent Kano attributes = supplementary variable.

A) ATTRIBUTE PRESENCE



B) ATTRIBUTE ABSENCE

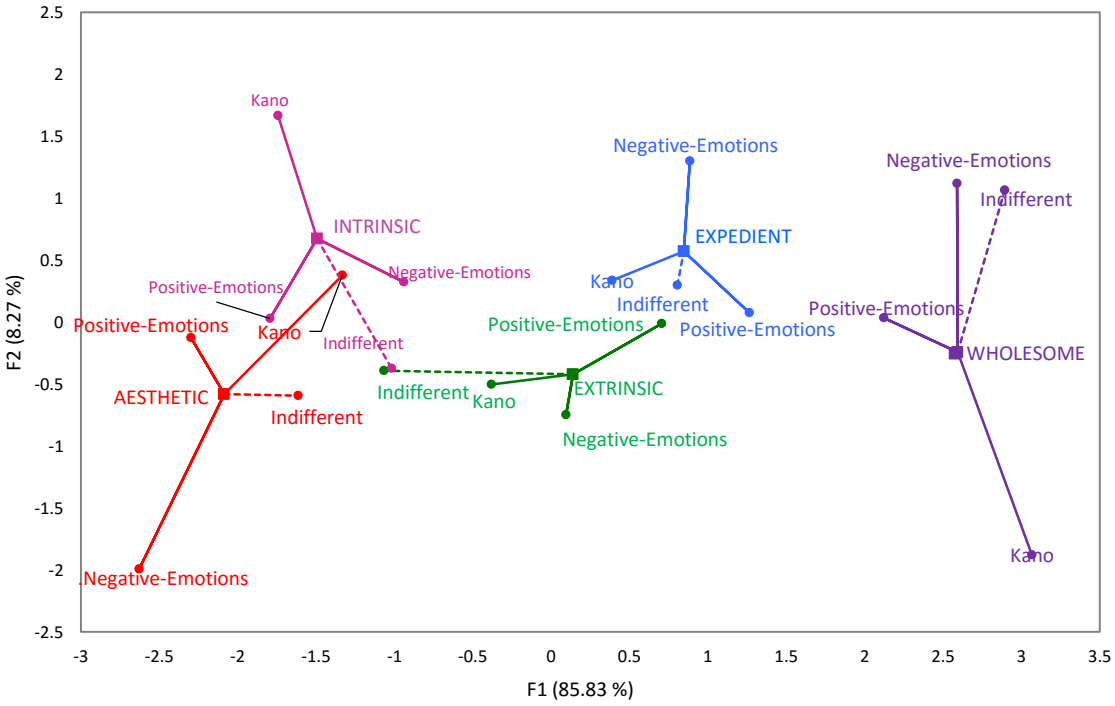


Figure 5.2 Multiple factor analysis individual product plots using Kano classification and emotions for (A) attribute presence and (B) absence conditions.

Table 5.1 Rv coefficients between Kano and emotion measures

Independent Variable	Attribute** Presence			Attribute Absence		
	Kano, SC-DSC	Positive Emotions	Negative Emotions	Kano, SC-DSC	Positive Emotions	Negative Emotions
Kano Categories*	-	-	-	-	-	-
Positive Emotions	0.805	-	-	0.758		
Negative Emotions	0.247	0.332		0.810	0.892	
MFA	0.842	0.880	0.679	0.913	0.941	0.960
SC-DSC†	-	-	-	-	-	-
Positive Emotions	0.875	-	-	0.660	-	-
Negative Emotions	0.273	0.332	-	0.804	0.892	-
MFA	0.868	0.894	0.679	0.887	0.919	0.971

* Kano category comprised of attractive attributes, one-dimensional attributes and must-be attributes.

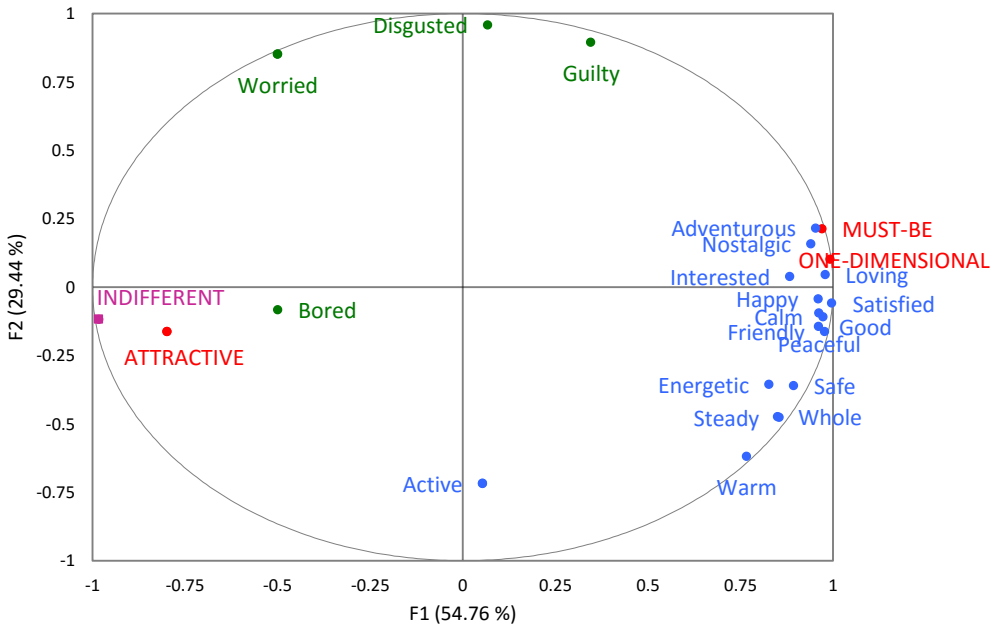
† Consumer satisfaction coefficients (SC, satisfaction [+]; DSC, dissatisfaction [−]).

**Egg quality attributes: Intrinsic = nutrient-fortified, organic, USDA-certified; Aesthetic = shell color, spotless eggshell, egg shape; Extrinsic = shell cleanness, thickness, surface smoothness, glossiness; Expedient = packaging type, sale price, egg size, product brand, egg grade, availability; Wholesome = freshness, 'packing/best-before-date', absence of visible cracks

Overall, must-be, attractive and one-dimensional Kano drivers of satisfaction showed agreement with positive emotions in attribute fulfilment, and with both positive and negative emotions in attribute nonfulfillment as seen from the foregoing (Figure 5.2; Table 5.1). This suggests a somewhat centralized mediating role for drivers of consumer satisfaction in the emotion response, which becomes clearer in the absence condition where attribute importance is accounted for.

The MFA variable correlation biplot (Figure 5.3) shows the underlying constructs between Kano and emotion attributes when considered simultaneously to describe the five egg quality groupings. The main dimension of variance opposes must-be and one-dimensional Kano attributes together with several positive emotions on one side, and attractive attributes and the negative emotion bored on the other side (Figure 5.3A). The second dimension accounting for 29.44% of the variation was however defined by active and the negative emotions – disgusted, guilty and worried with their vectors in opposite directions. As a result, Kano attributes are seen to be more closely related to pleasant emotions of a somewhat moderate to low arousal/intensity in attribute fulfilment. Considering the absence of the egg attributes however, stronger more distinct associations mostly contrary to that in attribute presence emerge (Figure 5.3B). Not surprising, must-be and one-dimensional attributes driving dissatisfaction, were strongly related to negative emotions while attractive attributes were seen contributing to both dimensions of the MFA, although mostly in the direction of positive emotions. Thus in the nonfulfillment of critical must-be and one-dimensional egg quality attributes, negative emotional responses became more profound, further confirming the concept of hedonic asymmetry as it relates to food emotions (Schifferstein and Desmet 2010), and the importance of incorporating the voice of the consumer in the process development process (Berger and others 1993).

A) ATTRIBUTE PRESENCE



B) ATTRIBUTE ABSENCE

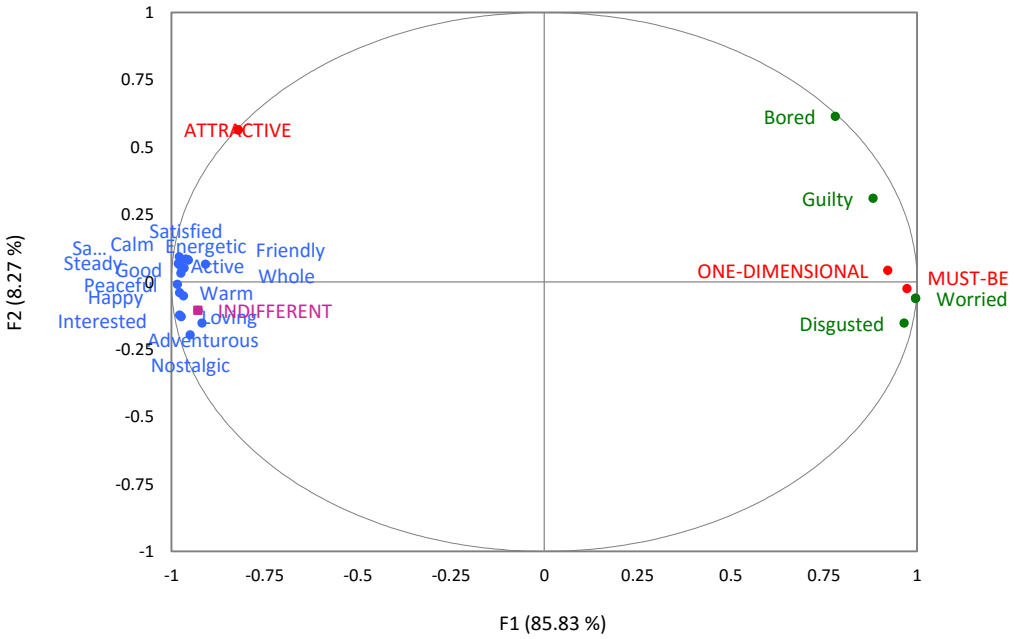


Figure 5.3 Multiple factor analysis variable correlation circle obtained using Kano classification and emotions for (A) attribute presence and (B) absence conditions.

To further investigate the constructs of satisfaction with emotions, MFA plots of the satisfaction coefficients derived from Kano frequencies and emotions were compared (Figure 5.4). From the variable correlation circle, satisfaction/dissatisfaction are both seen to tap into the same dimension as positive emotions in attribute presence *vs.* negative emotions in attribute absence.

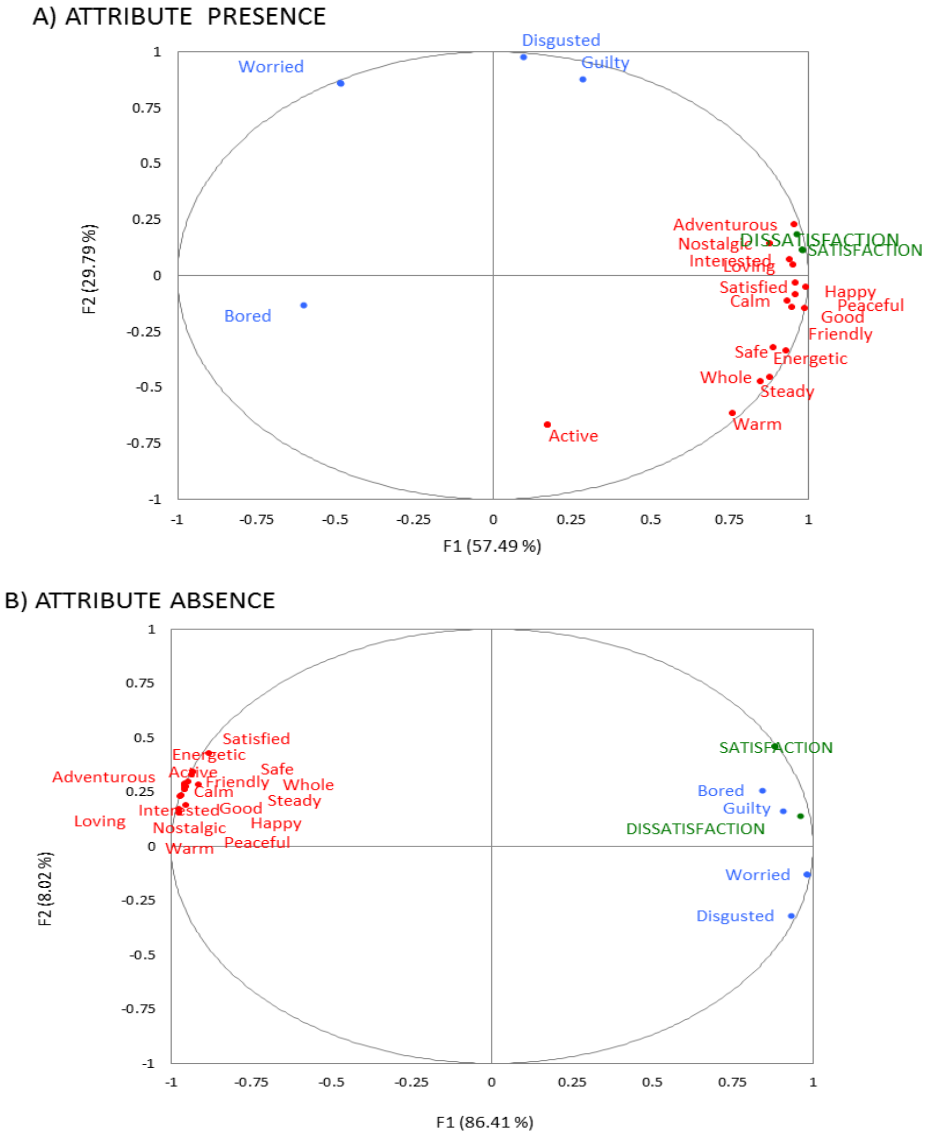


Figure 5.4 Multiple factor analysis variable correlation circle obtained using satisfaction/dissatisfaction coefficient and emotions for (A) attribute presence and (B) absence conditions.

5.3.2 Predicting product acceptability from emotions using logistic regression analysis (LRA)

Logistic regression analysis (LRA) was performed using a full model with all 20 emotion terms considered simultaneously in order to identify emotions influencing overall acceptability in both egg attribute presence and absence conditions (Table 5.2). For attribute presence, overall acceptability was significantly influenced by 5 positive emotions (active, friendly, good, happy and satisfied) *vs.* 4 positive emotions (active, adventurous, good and safe) in their absence. 2 negative emotion terms were significant in the LRA models in the presence (bored and worried) and absence (disgusted and worried) of attributes (Table 5.2). Accordingly, a greater number of high arousal emotions (active, adventurous and disgusted) are seen to influence overall liking in attribute absence rather than presence. These findings demonstrate the emotional effect of important or critical attributes on overall product acceptability.

Based on the odds ratio estimates, odds of liking of eggs in attribute presence would be 0.78 (friendly) – 1.56 (good) times higher than disliked for every 1-point increase in significant positive emotion scores compared to 1.30 (adventurous) – 1.49 (active) for attribute absence. However, for significant negative emotion scores, every 1-point increase in intensity would increase the chance of the eggs being disliked rather than liked by 43% (worried) and 45% (bored), compared to 19% (worried) and 41% (disgusted) for attribute presence *vs.* absence respectively (Table 5.2).

Table 5.2 Parameter estimates, probability, and odds ratio estimates for predicting acceptability of eggs with varying qualities based on emotions[a]

Independent Variable	Attribute Presence			Attribute Absence		
	Estimate	$Pr > \chi^2$	Odds Ratio	Estimate	$Pr > \chi^2$	Odds Ratio
Active	0.3241	0.002	1.383	0.3974	0.0002	1.488
Adventurous	0.1999	0.0697	1.221	0.2595	0.0099	1.296
Bored	-0.3721	<.0001	0.689	-0.0734	0.3733	0.929
Calm	0.0434	0.6569	1.044	0.1173	0.2795	1.124
Disgusted	-0.0430	0.7069	0.958	-0.3447	<.0001	0.708
Energetic	0.0837	0.4440	1.087	-0.0617	0.5835	0.940
Friendly	-0.2502	0.0229	0.779	0.004	0.9741	1.004
Good	0.4453	<.0001	1.561	0.3049	0.0050	1.356
Guilty	0.0519	0.6507	1.053	0.0291	0.7411	1.029
Happy	0.2805	0.0059	1.324	0.1783	0.1102	1.195
Interested	-0.0903	0.3673	0.914	0.0526	0.6047	1.054
Loving	-0.0103	0.9300	0.990	0.1349	0.2301	1.144
Nostalgic	0.0512	0.5895	1.052	0.1269	0.1455	1.135
Peaceful	0.0610	0.605	1.063	-0.1982	0.1204	0.820
Satisfied	0.2759	0.0123	1.318	0.1187	0.3244	1.126
Safe	0.1236	0.2055	1.132	0.3001	0.0036	1.350
Steady	0.1546	0.1837	1.167	0.1567	0.1965	1.170
Warm	-0.1828	0.1524	0.833	-0.1389	0.3102	0.870
Whole	0.0225	0.8337	1.023	0.0411	0.7373	1.042
Worried	-0.3584	0.0007	0.699	-0.1759	0.0288	0.839

[a]Based on a logistic regression analysis, using a full model of 20 emotion terms. Analysis of maximum likelihood estimates was used to obtain parameter estimates.
Parameter estimates considered significant based on the Wald χ^2 value at $P < 0.05$.

5.3.3 Predicting product acceptability from emotion and satisfaction constructs

The influence of emotions and the different dimensions of consumer satisfaction on the probability of eggs with expedient quality to be liked *vs.* disliked, were modeled using LRA. In addition, possible moderating effects of Kano categories on the link between emotions and acceptability were investigated. As seen from Table 5.3, emotions were found to be a more critical consumer affective response influencing overall acceptability compared to attribute

performance on satisfaction. The odds ratio of 1.702 for positive emotions indicated that the odds of expedient attributes being liked is 1.7 times higher than being disliked ($P < 0.001$) with every one unit increase in the intensity of positive emotions based on the 5-point emotion intensity scale of the EsSense Profile® (King and Meiselman 2010). Negative emotions on other hand were found to have a significant negative effect on liking with an odds ratio estimate of 0.396. Hence a unit increase in the intensity of negative emotions measured on a 5-point scale would result in eggs with expedient quality being 2.53 times more disliked than liked.

Table 5.3 Parameter estimates, probability, and odds ratios[a] for predicting acceptability of eggs with expedient** characteristics from emotion and satisfaction measures

Independent Variable	A Full Model			A Single Variable Model		
	Estimate	Pr > χ^2	Odds Ratio	Estimate	Pr > χ^2	Odds Ratio
Positive Emotions	0.5316	<.0001	1.702	0.3806	<.0001	1.463
Negative Emotions	-0.9254	<.0001	0.396	-0.4746	<.0001	0.622
Attractive*	0.5254	0.0438	2.860	0.2726	0.1860	1.725
One-dimensional	0.1340	0.5225	1.307	0.2851	0.0862	1.769
Must-be	0.0673	0.7409	1.144	-0.0585	0.7138	0.890
Indifferent	-0.0245	0.9050	0.952	-0.0888	0.5858	0.837

[a]Based on a logistic regression analysis, using a full model of 6 terms (2 emotion PCs; 4 Kano categories) and single-variable models. Analysis of maximum likelihood estimates was used to obtain parameter estimates. Parameter estimates considered significant based on the Wald χ^2 value at $P < 0.05$.

* Kano categories = attractive, one-dimensional, must-be attributes and indifferent attributes.

**Expedient egg qualities = packaging type (must-be), sale price (one-dimensional), egg size (attractive), product brand (indifferent).

For satisfaction measures, attractive attributes (egg size) were the only measure influencing acceptability ($P = 0.04$). One-dimensional (price; $P = 0.52$), must-be (secure package; $P = 0.74$) and indifferent (product brand, $P = 0.91$) attributes were not significant predictors of overall acceptability for eggs. The odds ratio estimate for attractive attributes was 2.86. Hence for a change in the attractive Kano attribute response from no to yes or going from small to larger egg

sizes, the odds that eggs with expedient attributes would be liked is 186% more than being disliked (Table 5.3). Additionally, unlike must-be (secure packaging) and indifferent (product brand) Kano categories, one-dimensional (lower sale price) Kano attribute was only marginally significant (P = 0.086) in predicting overall liking when considered alone without the other independent variables, but nonsignificant with them. Furthermore, no significant effect of the interactions between emotions and Kano attributes for predicting acceptability were found (data not shown). The observed relationship between emotions and liking was therefore found not to be moderated by satisfaction performance of expedient egg attributes.

5.4 Discussion

This study evaluated interrelationships between three consumer affective responses to foods: emotions, satisfaction and acceptability. In addition, it investigated possible moderating effects of Kano satisfaction attributes on the relationship between emotions and acceptability. This research extends current understanding of food-evoked emotions by examining its relation with the Kano typology of a product.

The underlying structure of the positive emotional profile of attributes important to the purchase decision of eggs was found to be more identical to that obtained by Kano frequencies than negative emotions. In understanding the emotional profile of foods therefore, satisfaction appears to be driven by similar product attributes driving positive emotional associations. However, since food-elicited emotions are often instinctive and transient in nature while the Kano model succinctly captures the voice of the consumer, satisfaction may offer a more direct approach for understanding the affective determinants of food choice than emotions.

The second observation made in the present study with the tested product is that emotions and Kano's typology accounted for more variation among egg products than the use of only emotions. This was expected since satisfaction measures a consumer's fulfillment response which may include levels of under- or over fulfillment, as well as both pleasant and unpleasant emotions thereby accounting for more of the variance. Traditionally, satisfaction has been considered as a cognitive state, influenced by cognitive antecedents including expectations, performance, disconfirmation of expectations, attribution, and equity (Oliver 1997; Bigné and others 2005).

The basic indicator for the level of quality of a product can be measured in terms of its basic or must-be Kano attributes. The presence of basic attributes in this study was more strongly linked to positive emotions than attractive attributes which generate satisfaction but not dissatisfaction. Hence, disconfirmation of strong expectations may be linked to unpleasant emotions to a greater extent than the presence of "delighters" may lead to pleasant emotions. Westbrook (1987) proposed and empirically validated a model in which disconfirmation of expectations and affect contributed independently to satisfaction, and Westbrook and Oliver (1991) found affect to be a mediator between disconfirmation and satisfaction.

The present findings can be applied in product development to gain holistic knowledge about product composition, sensory perception and consumers' affective responses to aid manufacturers to manipulate product attributes to enhance the emotional experience across the different stages of product-user interaction. Although researchers agree on the importance of emotions as determinants of food choice, there are no conclusive findings regarding their relationship with other consumer behaviors (Bigné and others 2005). Evidence from the present study indicated that, although associations were found between food-elicited emotion intensities

and expected or reflective satisfaction, they both influenced product acceptability independently. This may be due to other cognitive factors unaccounted for in this study which may be influencing liking. The impact of emotions on post consumption satisfaction measures particularly food sensory satisfaction, whether synergistic, buffering or antagonistic, needs to be addressed in future research.

5.5 Conclusions

Relationships among affective determinants of food choice were explored in this study using a combination of existing methods. The analysis showed a stronger association between the structures of Kano attributes of consumer satisfaction and positive emotions, than for negative emotions. Evidence of a moderating path of attribute performance on consumer satisfaction was not found on the relationship between emotions and liking for the egg product. Logit models showed that positive and negative emotions together with presence of attractive expedient attributes for eggs better predicted liking than perceived evoked emotions. Thus, consumer expectations and judgment of product attribute "delighters" were found to play a key role in consumer affective responses to the egg product. Overall, the results show that much of the variability in food emotions may be mediated by aspects contributing to consumer satisfaction and dissatisfaction, consequently affecting hedonic liking. This study contributes to the research stream on affective determinants of food choice, and suggests an underlying association between satisfaction and positive emotions. It also provides processors with insights to prioritize research and development resources in order to effectively enhance consumer satisfaction and desirable emotional responses to their products.

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CHAPTER 6.
INFLUENCE OF PACKAGE VISUAL CUES OF SWEETENERS ON THE SENSORY-EMOTIONAL PROFILES OF THEIR PRODUCTS

6.1 Introduction

The sensory-emotion profiles of food products have become an important tool for building holistic product understanding beyond liking especially in the current competitive marketplace where product homogeneity is commonplace (King and Meiselman 2010; Jiang and others 2014; Wardy and others 2015; Poonnakasem and others 2016). Food-elicited emotion assessment is a complex task since it measures distinct bodily and cognitive states stemming from a composite of experienced consequences; and is therefore affected by a large number of factors, both internal and external to the consumer (Richins 1997; Desmet and Schifferstein 2008; Thomson and Crocker 2013). Factors influencing emotion measurement include the type of food, eliciting condition (food names, flavor or aroma of tasted foods, food image), questionnaire format, time of day/location, number of products in a test session, and prior consumer emotional state (King and others 2010, 2013; Cardello and others 2012). Insightful interpretation of differences in the sensory-emotion profiles between products is therefore essential to guide the product development process.

The consumption of food has been shown to evoke mainly positive emotions since foods are generally consumed for a pleasurable effect (King and Meiselman 2010). Sweetness perception constitutes an integral part of the consumption experience and in many food products including beverages, sucrose and/or nonnutritive sweeteners are added to provide the strong sensory pleasure derived from the sweet taste (Drewnowski and others 2012). Global trends indicate increasing production and consumption of food products with nonnutritive sweeteners to help reduce costs as well as curb increasing rates of obesity (Mahar and Duizer 2002; Leitch and

others 2015). Due to the mostly positive emotional valence associated with foods, it is not surprising that sweetness may define acceptance of foods with cultural significance more so than the other basic tastes, and may be a principal source of food evoked emotion.

Several studies have investigated the power of crossmodal interactions on expectations and sensory experience. Effects of visual cues, particularly color type and intensity of food, packaging, labeling information, brand and food receptacle (serving cup/plate) on perceived flavor intensities, liking, texture and sensory thresholds have been reported in the literature (Maga 1974; Shankar and others 2009; Spence and others 2010; Piqueras-Fiszman and Spence 2011, 2012; Ngo and others 2012). These have been found to be affected by factors such as color-taste congruency, hedonic expectations and consumers' experiences (Piqueras-Fiszman and Spence 2015). Despite the vast body of work detailing the effects of color on cognition, affective responses and food preferences (Garber and others 2000; Levitan and others 2008; Shankar and others 2010; Piqueras-Fiszman and others 2012), its role remains elusive and difficult to quantify owing in large part to its multidimensionality which influences psychological functioning (Clydesdale 1993; Elliot and Maier 2014). For nonnutritive sweeteners, their distinct commercial brand names, color of packets and sensory attributes may enhance their familiarity or otherwise with consumers, thereby influencing consumer expectations about their food products.

The extent of consumer awareness and exposure to sucrose alternatives may result in different consumer expectations relating to sensory liking, desirable intake amounts, and function in promoting health or otherwise. This coupled with both existing and evolving cultural significance and varying meanings associated with different colors by consumers may cause their visual branding to be of import as it may function as a tool to modulate sweet taste preferences

and associated emotions (Shankar and others 2010; Spence 2015; Porcherot and others 2013). To date, no studies have been reported in the literature examining such effects. Mahar and Duizer (2007) observed that, the type of sweetener, whether natural or artificial and the amount typically consumed by individuals had no effect on sweetness intensity ratings. More so, they found a positive relationship between increasing sweetness liking and the amount of sweetener typically consumed by individuals rather than by the type of sweetener. Leitch and others (2015) in evaluating consumer acceptability and emotional responses to sweeteners (sucrose, ace-k, sucralose, high fructose corn syrup and honey) found four unique terms (disgusted, good, mild, steady) for natural sweeteners, and two unique terms (bored, good-natured) for artificial sweeteners. As pertains to the growing body of research relating to the effect of packaging cues on emotions, Gutjar and others (2015a) showed that prediction of food choice based on packaging involved two emotion dimensions, valence (unpleasant/pleasant) and arousal (calm/excitement) as opposed to only valence when based on intrinsic sensory properties. Liao and others (2015) recently demonstrated the power of packaging imagery on eliciting emotional response even for short durations of exposure, and significant effects of packaging colors and typefaces only by self-report rather than physiological emotion measures. Still, in the domain of sweeteners, research exploring effects of packaging cues on consumer affective responses remains rare.

The objectives of this study were therefore to assess the relative impact of aspects of the distinct branding of sweeteners (name and packet color) on consumer acceptability (sweetness/overall liking) and emotion ratings.

6.2 Materials and Methods

6.2.1 Participants and test samples

The protocol for this study was approved (IRB# HE 15-9) by the Louisiana State University (LSU) Agricultural Center Institutional Review Board. Participants (n = 560) were recruited from Baton Rouge, LA, USA., and their demographic characteristics (aged ≥ 18 years; 57% male; 43% female), awareness of different sweetener color packets and attitudes concerning sucrose and nonnutritive sweeteners were assessed by a background questionnaire. Consumer awareness of sweetener color packets was validated by correct matching of sweetener name to packet color. For those with an incorrect match, their responses were omitted from the analyses.

Sweet tea beverage (4% sucrose concentration) was used as a food model for sweetener application due to its lack of novelty to consumers. Panelists were screened for allergic reaction to tea, and liking for sweet tea. 5 sweetener types were evaluated; sucrose and 4 commercially available sucrose alternatives visually branded by their packet colors yellow (sucralose), green (stevia), pink (saccharin), and blue (aspartame). Sucrose was depicted as regular cane sugar with a white packet.

6.2.2 Experimental procedure and eliciting conditions

In order to investigate the influence of the packet color of sweeteners on product evoked emotions, sweetness and overall acceptability, two different conditions consisting of varying sweetener information were utilized. Eliciting stimuli for the ‘control’ condition consisted of only the sweetener/brand name, while for the ‘informed’ condition, sweetener/brand name along with an image of the packet were presented, with the obvious difference in conditions being the

color of the sweetener packet. These two conditions were used to analyze whether the increased detail of product information provided by the informed condition would reveal a latent influence of the color of the packet on consumer perception.

In line with the aims of the study, 'blind' tastings were conducted in order to avoid actual effects of sweetness perception imparted by the sweeteners on consumer responses. Panelists were informed that, all tea samples were sweetened with either sucrose or one of the four nonnutritive sweeteners. However, all tea samples were sweetened with only sucrose. Since independent and instantaneous consumer reactions to the different experimental stimuli were required to be able to address the research objectives satisfactorily, the use of different panelists between groups was necessary to minimize the possibility of errors due to fatigue, habituation and carryover effects between the two conditions. Thus a panelist evaluated a set of 5 identical samples of sweet tea under only one of the 2 eliciting conditions, generating a 2 (eliciting condition) x 5 (sweetener type) mixed between/within subjects experimental design. Samples were served in a balanced order within each condition to offset effects of order bias (MacFie and others 1989; Stone and Sidel 2004), and panelists were randomly assigned to treatments within a condition (n = 280 /condition).

6.2.3 Sensory and emotions testing

Selection of emotion terms associated with sweeteners was done in preliminary studies where emotion terms from the EsSense Profile® (King and Meiselman 2010) for the measurement of food-related emotions, were screened for relevance to the sweet taste using the check-all-that-apply (CATA) method. Consumers (n = 80) of both sucrose and nonnutritive sweeteners were recruited for selection of emotion lexicons. Emotion terms with a frequency of

20% or higher were selected (King and Meiselman 2010; Wardy and others 2015), resulting in a final list of 12 descriptors (bored, calm, disgusted, free, good, guilty, happy, peaceful, pleased, satisfied, safe and worried). 'Secure' was subjectively modified to 'safe', to more accurately capture possible safety concerns some consumers may or may not associate with nonnutritive sweeteners.

Panelists were seated in fluorescent-lit partitioned sensory booths for product evaluation. Information as to the requirements of the test in both written and verbal formats was conveyed, after which informed consent was obtained. 20 mL of tea samples were served in 3 oz. opaque white cups at ambient temperature. Panelists were instructed to taste each of the 5 samples presented (labeled with a random 3-digit code) from left to right, and rate each one according to their perception, being cognizant of the product information presented as per the eliciting condition. For example, for a given tea sample in the control condition, panelists were informed that it was sweetened with a specific sweetener (for example aspartame), while for the informed condition, there was added information that, the picture of the sweetener packet was shown. Water and unsalted crackers were used to neutralize perception between samples.

Sensory and emotion ballots were administered using Compusense® five, version 5.6 (Compusense Inc., Guelph, Ontario, Canada). Sweetness liking and overall acceptability of samples were first rated using a 9-point hedonic category scale (1 = dislike extremely, 5 = neither dislike nor like, 9 = like extremely; Peryam and Pilgrim 1957). Prior to assessing emotions associated with the product which followed the sensory evaluation, information on type of sweetener used in the tea was displayed again, and sample re-tasting was encouraged. Emotion terms were listed alphabetically and their intensities rated (1 = not at all; 2 = slightly; 3

= moderately; 4 = very; 5 = extremely; King and Meiselman 2010), with subjects instructed to describe how they felt 'now' based on the taste of the sample and condition information.

6.2.4 Statistical analyses

Data analysis was done using the SAS software (SAS, version 9.4, 2003) at $\alpha = 0.05$. Proc Mixed was to analyze significance of main effects on emotion and acceptability ratings using a repeated measures ANOVA with eliciting condition (2 levels) as between-subjects factor and sweetener type (5 levels) as within-subjects factor. Separate one-way ANOVA's and Tukey's *post-hoc* tests for each eliciting condition were conducted across sweeteners (emotions and acceptability) and within sweetener (emotions) to detect significant differences in acceptability and emotional profiles using Proc Glm. Unpaired *t*-tests were used to specify differences in attribute ratings across the two eliciting conditions in order to determine effects of the color of the packet. Pearson's correlation coefficients (r) between sweetness/overall acceptability and emotion scores were computed for both eliciting conditions. Multivariate analysis of variance (MANOVA) was performed to further determine whether consumer sensory perception and emotional responses were simultaneously affected by 10 sweetener types (5 sweetener types * 2 eliciting conditions), and also for 5 sweetener types within each eliciting condition. Subsequently, comparisons between sensory and emotion ratings of sweeteners within and across eliciting condition were then characterized using the pairwise squared distances between group mean vectors (Mahalanobis distance, D^2) given by Proc Candisc. When MANOVA indicated a significant overall difference, canonical correlations from descriptive discriminant analysis (DDA, Huberty 1994) were compared to arbitrarily identify critical attributes (canonical correlations $\geq \pm 0.4$) underlying differences among sweeteners.

6.3 Results

6.3.1 Sweetness and overall liking

The repeated measures ANOVA (Table 6.1) performed on acceptability ratings revealed a significant main effect of sweetener type on sweetness liking ($F_{4, 2232} = 26.98$, $P < 0.0001$) and overall liking ($F_{4, 2232} = 34.06$, $P < 0.0001$) indicating that different sweeteners affected participants liking of sweet tea. However, neither sweetness nor overall liking showed a main effect of eliciting condition ($F_{1, 558} = 0.01$ and 0.10 respectively), and sweetener type by eliciting condition interaction ($F_{4, 2232} = 0.92$ and 1.09 respectively), suggesting that the different packet colors of sweeteners did not exert any significant impact on consumer liking of the beverage.

Table 6.1 Significance of the main and interaction effects for emotions and sensory attributes

Attributes	Sweetener	Condition†	Sweetener * Condition
Bored	<0.0001*	0.3553	0.6362
Calm	<0.0001	0.3887	0.1429
Disgusted	<0.0001	0.9526	0.3009
Free	0.3395	0.6064	0.5399
Good	<0.0001	0.5696	0.8235
Guilty	0.0093	0.3411	0.2895
Happy	0.0090	0.6297	0.6535
Peaceful	<0.0001	0.2962	0.0172
Pleased	<0.0001	0.8802	0.7384
Satisfied	<0.0001	0.7585	0.7616
Safe	<0.0001	0.2779	0.3174
Worried	0.5049	0.4598	0.5132
Sweetness liking	<0.0001	0.9058	0.4532
Overall liking	<0.0001	0.7491	0.3595

*P value from Proc Mixed at $\alpha = 0.05$ ($N = 560$).
†Eliciting conditions: Control = sweetener/brand name; Informed = sweetener/brand name and packet image.

Figure 6.1 compares the mean ratings of sweetness and overall liking among sweeteners for the two eliciting conditions. Sweetness and overall liking for sucrose were rated significantly higher ($P < 0.05$) than for nonnutritive sweeteners both in the control condition (5.94 *vs.* 5.18 – 5.49 and 6.03 *vs.* 5.16 – 5.53 respectively), and the informed condition (6.06 *vs.* 5.09 – 5.43 and 6.20 *vs.* 5.13 – 5.51 respectively). No differences were found in acceptability ratings between nonnutritive sweeteners within an eliciting condition ($P > 0.05$). In addition, differences in acceptability ratings for a sweetener across eliciting conditions were nonsignificant ($P > 0.05$; a t-test).

In summary, differences in judgment of sweetness and overall liking were found. However, effect of sweetener type was more profound than impact of the color of the sweetener packet.

6.3.2 Emotional attributes

Generally, there was a significant main effect of sweetener type on emotions ($P < 0.05$) except for free and worried; and no main effect of eliciting condition nor their interaction, except a significant interaction for the emotion peaceful (Table 6.1). Mean emotion intensities for the different sweeteners are presented in Table 6.2. Range of emotion ratings across all sweeteners was slightly higher in the informed condition (2.0) than in the name condition (1.8). Specifically for positive emotions, the range was 0.5 *vs.* 0.6 and for negative emotions, the range was 0.8 *vs.* 0.9 for name *vs.* informed conditions, respectively. For each sweetener, positive emotions were consistently experienced with a greater intensity ($P < 0.05$) than negative emotions regardless of eliciting condition, however a greater number of positive emotions with the highest intensities ($P > 0.05$) were observed for the control rather than the informed condition (Table 6.2; ANOVA).

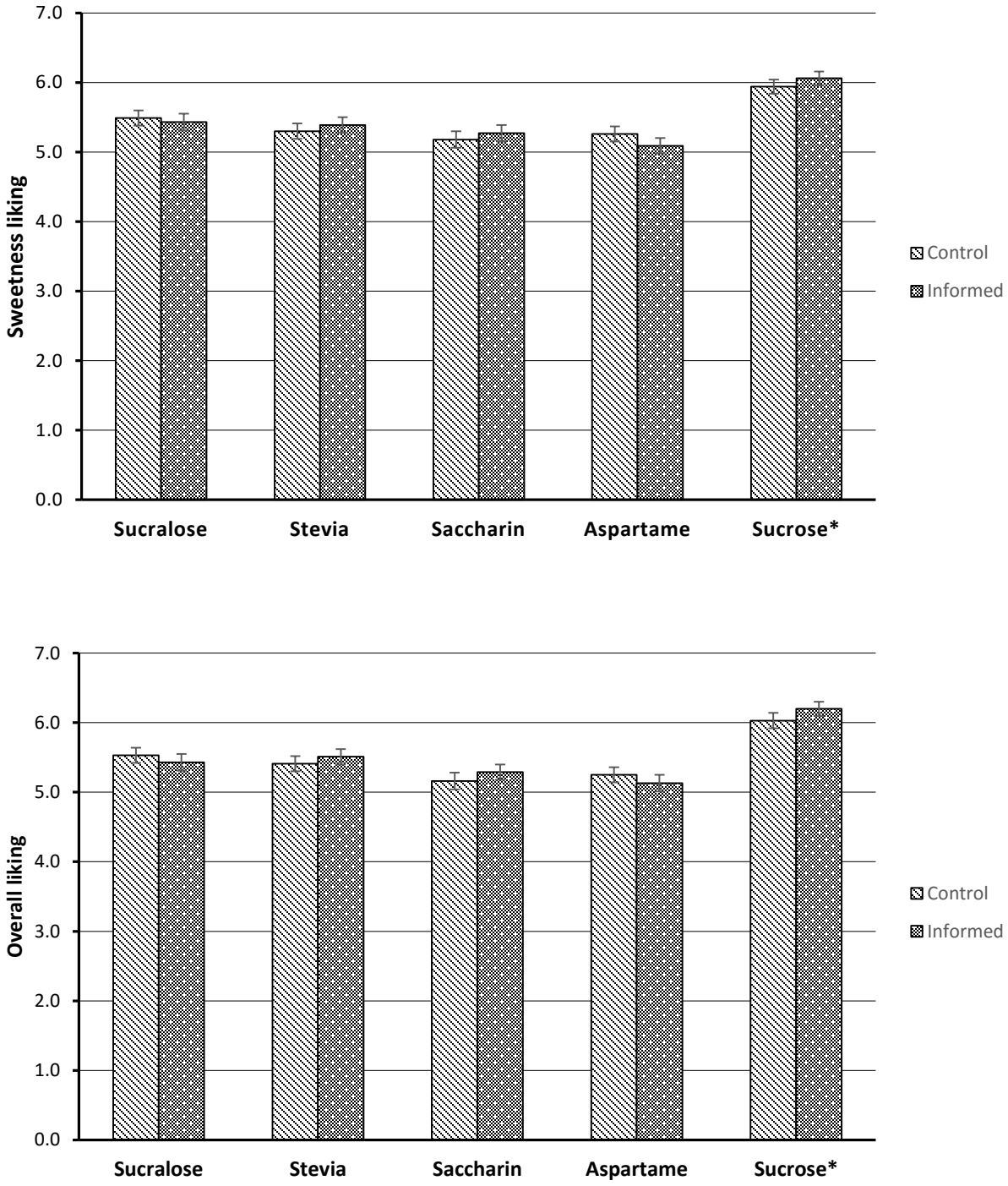

Figure 6.1 Effects of sweetener type and eliciting condition on hedonic ratings (Mean ± SEM bars) of sweetness (above) and overall liking (below). For all charts, (▨) = eliciting condition based on sweetener name only; (▩) = eliciting condition based on both sweetener name and packet image (N = 280/condition). * Ratings were significantly different ($P < 0.05$; ANOVA) from the other sweeteners regardless of eliciting condition.

These findings suggest that, sweetener package may be driving emotions more than sweetener names, with negative emotions being more discriminating than positive emotions.

For the positive emotions calm, good, happy, and peaceful, significant differences among mean emotion scores across sweeteners were found in the informed condition ($P < 0.05$), but not in the control condition; contrasting that observed for the emotion safe. However, the negative emotions bored and disgusted discriminated between sweeteners in both eliciting conditions ($P < 0.05$), while guilty and worried did not (Table 6.2; ANOVA). Where significant differences were detected, they were located between sucrose and nonnutritive sweeteners, but not among nonnutritive sweeteners regardless of eliciting condition. Therefore, similar to acceptability ratings, consumers' emotional responses to sucrose was distinct from that of the sugar substitutes, and this may be due to the reduced uncertainty and/or higher expectations arising from greater familiarity to sucrose.

To clarify the apparent impact of sucrose on emotional responses, the emotional profiles of the sugar substitutes were generated using sucrose as the baseline for both eliciting conditions (Figure 6.2). Subsequently, results demonstrated a trend of significantly lower ($P < 0.05$) intensity of positive emotions for sugar substitutes compared to sucrose, and *vice versa* for negative emotions except for the emotions worried and free in both eliciting conditions (Table 6.2 and Figure 6.2).

Furthermore, evaluation of the emotion intensities associated with sweeteners across eliciting conditions revealed greater influence of the packet color on negative than positive emotions. Significant decreases in the negative emotions bored (aspartame), disgusted (sucrose), guilty (sucralose and aspartame), and worried (saccharin), and a significant increase in disgusted (aspartame), were found when passing from the control to the informed condition (Table 6.2; *t*-

test, $P \leq 0.05$). Generally for positive emotions, slight increases were found moving from the control to the informed condition, however these were nonsignificant (Table 6.2 and Figure 6.2).

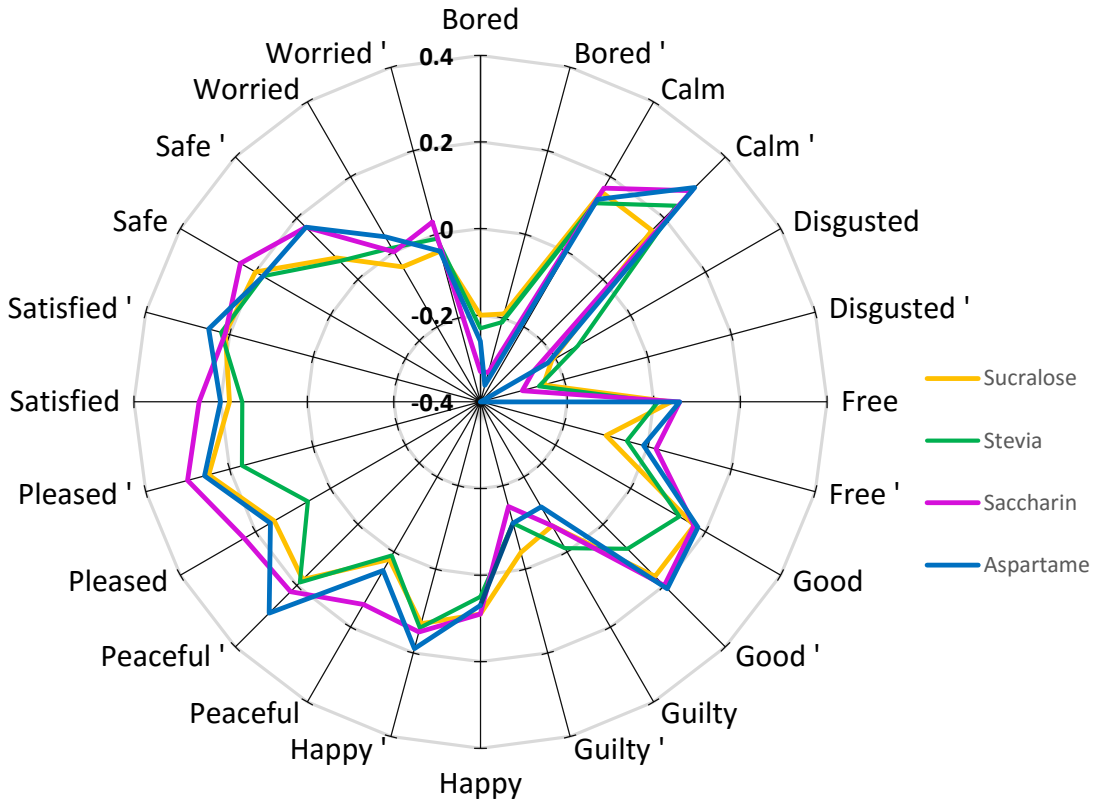

Figure 6.2 Emotional profiles of nonnutritive sweeteners in the control (name) and informed (name and packet image) conditions using emotional responses for sucrose as baseline. ′ denotes emotion responses in the informed condition. For all charts, (—) = Sucralose; (—) = Stevia (—) = Saccharin; (—) = Aspartame.

Table 6.2 Effects of eliciting conditions† on mean emotion ratings*

Emotions	Sucralose		Stevia		Saccharin		Aspartame		Sucrose	
	Control	Informed	Control	Informed	Control	Informed	Control	Informed	Control	Informed
Bored	2.00^{Ab}	2.04^{ABd}	2.03^{Ab}	2.06^{Ae}	2.13^{Ac}	2.18^{Ad}	2.06^{Ab}	2.21^{Ad**}	1.80^{Bc}	1.85^{Bd}
Calm	2.99^{Aa}	3.13^{ABa}	3.02^{Aa}	3.05^{Babc}	2.98^{Aab}	3.00^{Babc}	3.01^{Aa}	2.99^{Babc}	3.15^{Aa}	3.29^{Aa}
Disgusted	1.60^{Ac}	1.56^{Ae}	1.53^{ABc}	1.57^{Af}	1.65^{Ad}	1.61^{Ae}	1.61^{Ac}	1.71^{Ae**}	1.39^{Bd}	1.31^{Be**}
Free	2.80^{Aa}	2.92^{Aabc}	2.83^{Aa}	2.87^{Abcd}	2.78^{Aab}	2.80^{Aabc}	2.78^{Aa}	2.83^{Aabc}	2.84^{Ab}	2.82^{Ac}
Good	3.01^{Aa}	3.05^{Bab}	3.05^{Aa}	3.14^{Ba}	3.01^{Aa}	3.02^{Bab}	3.00^{Aa}	3.01^{Bab}	3.18^{Aa}	3.22^{Aab}
Guilty	1.45^{Ac}	1.34^{Ae**}	1.39^{Ac}	1.41^{Af}	1.45^{Ad}	1.45^{Ae}	1.50^{Ac}	1.41^{Af**}	1.38^{Ad}	1.30^{Ae}
Happy	2.94^{Aa}	3.00^{ABabc}	2.98^{Aa}	2.99^{ABabcd}	2.94^{Aab}	2.98^{ABabc}	2.96^{Aa}	2.94^{Babc}	3.03^{Aab}	3.13^{Aab}
Peaceful	2.96^{Aa}	3.01^{Babc}	2.97^{Aa}	3.00^{Babcd}	2.84^{Aab}	2.97^{Babc}	2.93^{Aa}	2.90^{Babc}	2.98^{Aab}	3.19^{Aab}
Pleased	2.81^{Ba}	2.78^{Bbc}	2.90^{ABa}	2.86^{ABcd}	2.73^{Bab}	2.73^{Bc}	2.80^{ABa}	2.77^{Bbc}	2.96^{Aab}	3.03^{Aabc}
Satisfied	2.78^{ABa}	2.75^{ABc}	2.81^{ABa}	2.74^{Bd}	2.71^{Bb}	2.75^{ABbc}	2.76^{ABa}	2.71^{Bc}	2.96^{Aab}	2.96^{Abc}
Safe	3.01^{Ba}	3.17^{Aa}	3.03^{Ba}	3.18^{Aa}	2.97^{Bab}	3.07^{Aa}	3.03^{Ba}	3.07^{Aa}	3.21^{Aa}	3.24^{Aab}
Worried	1.51^{Ac}	1.45^{Ae}	1.46^{Ac}	1.42^{Af}	1.47^{Ad}	1.38^{Ae**}	1.43^{Ac}	1.45^{Aef}	1.47^{Ad}	1.41^{Ae}

***** Mean values based on a 5-point scale (1 = not at all and 5 =extremely).

† Eliciting conditions (n = 280/condition): Control **=** sweetener/brand name; Informed = sweetener/brand name and packet image.

$^{A-B}$ Values in the same row with different superscripts are significantly different within a condition ($P < 0.05$).

$^{a-e}$ Values in the same column with different superscripts are significantly different within a condition ($P < 0.05$).

**Denotes significant differences between eliciting conditions based on the independent sample t-test ($P < 0.05$).

6.3.3 Sensory-emotion space of sweeteners as affected by sweetener type and eliciting condition

As seen from the MANOVA (Table 6.3), mean vectors of both sensory and emotion ratings were significantly different among 5 sweetener types in the control condition (Wilks' Λ= 0.944, $F_{4, 1395}$ = 1.43, P = 0.02), informed condition (Wilks' Λ= 0.918, $F_{4, 1395}$ = 2.14, P < 0.0001), and for all 10 (5 types of sweeteners * 2 eliciting conditions) treatment combinations (Wilks' Λ= 0.925, $F_{9, 2790}$ = 1.73, P < 0.0001). Following MANOVA, DDA revealed that the two most critical attributes underlying perceived differences among sweeteners regardless of eliciting condition were sweetness and overall liking as seen from their higher canonical correlation coefficients (Table 6.3; Can 1). However, critical emotions differentiating sweeteners differed across eliciting conditions (Table 6.3; canonical coefficient $r \geq \pm 0.4$). The name only condition was defined by 2 negative emotions: bored and disgusted, while the informed condition was defined by both positive and negative emotions: disgusted, bored, calm, pleased and peaceful. Thus, while sensory perception was more affected than emotions by either the name or name/packet image of the sweetener, influence of the latter was greater on emotional responses than the former. Separate MANOVA analysis based on eliciting conditions provided further evidence of the influence of the packet color on the sensory-emotion space of sweeteners (Table 6.3). Significance of overall differences observed among sweeteners for the control (P = 0.0202) was found to be lower than for the informed condition (P < 0.0001). In addition, DDA revealed 4 differentiating variables for control *vs.* 5 for informed, and sensory and emotion attributes differentiating sweeteners for the informed condition matched that of the pooled data more closely than the control condition (Table 6.3).

Table 6.3 Comparison of variables differentiating among sweeteners based on the pooled within canonical structure (*r's*)*

Attributes	Control†			Informed			All		
	Can 1[a]	Can 2[a]	Can 3[a]	Can 1	Can 2	Can 3	Can 1	Can 2	Can 3
Bored	*-0.522*	-0.015	-0.027	*-0.447*	-0.010	0.120	*-0.496*	-0.049	0.073
Calm	0.257	-0.122	-0.177	*0.420*	-0.154	-0.162	*0.360*	-0.037	0.111
Disgusted	*-0.422*	-0.104	0.351	*-0.528*	0.097	-0.161	*-0.499*	-0.118	-0.243
Free	0.084	0.118	-0.135	0.007	0.015	*-0.345*	0.050	0.110	-0.330
Good	0.300	-0.094	-0.306	0.299	0.289	0.105	0.309	0.253	0.286
Guilty	-0.160	-0.265	*0.457*	-0.231	0.107	0.321	-0.223	-0.091	0.156
Happy	0.136	-0.021	-0.159	0.240	-0.081	0.060	0.201	0.011	0.157
Peaceful	0.146	0.313	0.164	*0.358*	-0.099	0.097	0.267	0.093	-0.115
Pleased	0.293	0.293	-0.232	*0.375*	0.267	0.036	*0.356*	*0.436*	0.159
Satisfied	0.337	0.069	-0.142	0.313	-0.092	0.193	0.335	0.035	0.284
Safe	0.324	-0.119	-0.095	0.194	0.087	-0.140	0.260	0.118	0.023
Worried	0.044	0.145	0.088	-0.014	0.052	*-0.354*	0.022	-0.067	*-0.373*
Sweetness liking	*0.717*	-0.050	0.108	*0.685*	-0.120	0.153	*0.717*	-0.195	0.137
Overall liking	*0.787*	0.148	-0.042	*0.762*	0.050	0.239	*0.797*	0.038	0.184
% variance explained	72.29	12.72	9.04	73.52	13.04	10.08	83.05	9.39	5.96
P > *F*[c]	0.0202			<.0001			<.0001		

*Based on the pooled within group variances with *P* > F of Wilks' Lambda from MANOVA for both eliciting conditions. Italicized values indicate attributes largely contributing to the overall differences among all sweeteners. Cut-off canonical coefficient value: ≥ ±0.4.

†Eliciting conditions (*n* = 280/condition): Control = sweetener/brand name; Informed = sweetener/brand name and packet image.

[a] Can 1, Can 2 and Can 3 refer to the pooled within canonical structure in the first, second and third canonical discriminant functions, respectively.

Both the higher significance from MANOVA for the informed condition, and the greater number of discriminating variables compared to only sweetener names suggests that, differences in appearance/packaging likely influenced the sensory-emotional profile of the sweeteners.

Mahalanobis distances (D^2) from MANOVA were further utilized to better capture the separation among sweeteners based on sensory and emotional responses (Table 6.4). The results reflect relative positions of the sweeteners within and across eliciting conditions in the multivariate space. Generally, D^2 values found to be significant at $\alpha = 0.05$ for either eliciting condition were between sucrose and the nonnutritive sweeteners, suggesting effects due to the more familiar sucrose maximizing perceptual differences. Subsequently, significant D^2's among sweeteners in the informed condition (0.27 – 0.54) were greater in magnitude than those in the control condition (0.24 – 0.33), and also when comparing across eliciting conditions (0.21 – 0.50). Specifically, the greatest separation (0.54) in the informed condition was between aspartame and sucrose (0.54) while in the name condition, it was between saccharin and sucrose (0.33). Even though the separation between sugar and sucralose in the name condition was not significant, it was significant in the informed condition and when comparing across eliciting conditions.

Significant correlations between hedonic liking and emotions ($P < 0.05$) were observed for sweeteners in both eliciting conditions (Table 6.5). Strong relationships ($r > 0.5$; Cohen 1977) between emotions and sweetness liking for each sweetener varied based on eliciting condition. Sweetness liking was strongly associated with the emotion satisfied (sucralose, saccharin) only in the control condition, whereas it was strongly associated with the emotions pleased and satisfied (stevia), disgusted (aspartame) and satisfied (sucrose) only in the informed condition.

Table 6.4 Mahalanobis distance (D^2) matrix among sweeteners and eliciting conditions† based on sensory and emotion ratings

	Control					Informed				
	Sucralose	Stevia	Saccharin	Aspartame	Sucrose	Sucralose	Stevia	Saccharin	Aspartame	Sucrose
Control										
Sucralose	***									
Stevia	0.057	***								
Saccharin	0.100	0.073	***							
Aspartame	0.074	0.066	0.041	***						
Sucrose	0.167	**0.241***	**0.334**	**0.295**	***					
Informed										
Sucralose	0.069	0.099	0.111	0.117	**0.211**	***				
Stevia	0.091	0.081	0.124	0.116	**0.214**	0.103	***			
Saccharin	0.112	0.128	0.073	0.057	**0.380**	0.111	0.128	***		
Aspartame	0.121	0.074	0.040	0.075	**0.406**	0.115	0.096	0.074	***	
Sucrose	**0.251**	**0.330**	**0.497**	**0.415**	0.116	**0.265**	**0.290**	**0.449**	**0.539**	***

*Bolded numbers indicate D^2 measures that were significant at $P < 0.05$.

†Eliciting conditions (n = 280/condition): Control = sweetener/brand name; Informed = sweetener/brand name and packet image.

Table 6.5 Pearson correlation coefficients (r)[a] between emotions and acceptability ratings for different sweeteners

	Emotions	Sucralose		Stevia		Saccharin		Aspartame		Sucrose	
		Ctrl[†]	Info[†]	Ctrl	Info	Ctrl	Info	Ctrl	Info	Ctrl	Info
Sweetness liking-Emotion	Bored	-0.34	-0.32	-0.33	-0.18	-0.37	-0.30	-0.27	-0.28	-0.23	-0.10*
	Calm	0.15	0.22	0.24	0.25	0.19	0.13	0.13	0.23	0.06*	0.19
	Disgusted	-0.45	-0.48	-0.44	-0.49	-0.43	-0.48	-0.37	**-0.59**	-0.34	-0.29
	Free	0.16	0.16	0.21	0.16	0.17	0.07*	0.18	0.17	0.04*	0.24
	Good	0.43	0.38	0.40	0.37	0.39	0.29	0.32	0.29	0.33	0.43
	Guilty	-0.13	-0.19	-0.13	-0.17	-0.27	-0.17	-0.16	-0.31	-0.04*	-0.01*
	Happy	0.36	0.30	0.31	0.36	0.37	0.25	0.26	0.32	0.35	0.36
	Peaceful	0.19	0.27	0.24	0.29	0.27	0.21	0.25	0.28	0.21	0.25
	Pleased	0.45	0.49	0.41	**0.51**	0.46	0.41	0.37	0.42	0.44	0.48
	Satisfied	**0.51****	0.45	0.42	**0.55**	**0.51**	0.44	0.39	0.46	0.44	**0.56**
	Safe	0.18	0.21	0.20	0.20	0.20	0.20	0.20	0.20	0.16	0.31
	Worried	-0.21	-0.26	-0.17	-0.19	-0.15	-0.18	-0.15	-0.35	-0.06*	-0.18
Overall liking-Emotion	Bored	-0.35	-0.30	-0.36	-0.17	-0.40	-0.34	-0.32	-0.27	-0.26	-0.15
	Calm	0.14	0.24	0.28	0.25	0.18	0.18	0.12*	0.27	0.08*	0.27
	Disgusted	**-0.58**	**-0.51**	**-0.56**	-0.50	**-0.53**	**-0.53**	-0.45	**-0.61**	-0.41	-0.37
	Free	0.12*	0.16	0.22	0.14	0.14	0.17	0.13	0.23	0.03*	0.31
	Good	0.46	0.42	0.42	0.39	0.39	0.39	0.33	0.38	0.37	0.46
	Guilty	-0.20	-0.19	-0.22	-0.18	-0.32	-0.21	-0.19	-0.34	-0.03*	-0.04*
	Happy	0.35	0.34	0.35	0.37	0.34	0.34	0.27	0.38	0.33	0.42
	Peaceful	0.23	0.29	0.29	0.31	0.24	0.27	0.20	0.33	0.25	0.35
	Pleased	0.49	**0.52**	**0.51**	**0.52**	0.47	0.49	0.39	**0.53**	**0.52**	**0.58**
	Satisfied	**0.53**	**0.51**	0.49	**0.56**	0.49	**0.54**	0.44	**0.57**	**0.53**	**0.62**
	Safe	0.18	0.22	0.23	0.20	0.19	0.26	0.13	0.26	0.18	0.38
	Worried	-0.25	-0.19	-0.29	-0.20	-0.22	-0.22	-0.24	-0.37	-0.13	-0.17

[†]Eliciting conditions (n = 280/condition): Control (Ctrl) = sweetener/brand name; Informed (Info) = sweetener/brand name and packet image. [a] For the null hypothesis (Ho): r = zero. * Correlations are not statistically significant ($P \geq 0.05$). ** Bolded numbers denotes strong correlations based on Cohen's (1977) criteria: strong= $r > 0.5$; moderate= $0.3 < r < 0.5$; small= $r < 0.3$.

Results however revealed more similarities in strong correlations between emotions and overall liking across eliciting conditions. For example, overall liking had strong associations to the emotions disgusted (sucralose, saccharin), satisfied (sucralose, sucrose), and pleased (stevia, sucrose) in both control and informed conditions. Specifically for aspartame however, all strong relationships between overall liking and emotions were observed in the informed condition.

Altogether, eliciting conditions impacted the relative positions of the sweeteners in the sensory-emotion space, as well as variations in the association between liking and emotions.

6.4 Discussion

Assessing the emotionality of different food types remains a pertinent topic for the sensory field mainly due to the correlation or otherwise to product liking and purchase decision. Besides the actual taste of a product, consumer perception and choice of products have been shown to be influenced by consumer attitudes, packaging characteristics, and a variety of other product attributes (Mueller and Szolnoki 2010; Leitch and others 2015; Spinelli and others 2015; Wardy and others 2015). The premise of this work is that, the characteristic packet colors of sweeteners may generate expectations, and likely reflects sensory impressions about product characteristics, thereby influencing hedonic liking and consumer emotions.

Analyses of acceptability and emotion ratings of equi-sweet tea samples in both the control and informed conditions provided further experiential evidence of the influence of food packaging cues on consumer liking and emotion. The present study revealed independent effects of sweetener name and packet color (yellow, green, pink, blue, white) on acceptability ratings and emotions (except peaceful). This is not unexpected since consumers vary in their taste preferences, expectations and associations with different sweeteners and colors, as well beliefs

about their functionality leading to an averaging effect on ratings. Similar additive effects of label cues and color on flavor perception has been reported by Shankar and others (2009), and is in agreement with the cognitive model proposed by Sakai and others (2005).

In this study, significant differences among sweeteners in participants' sweetness and overall liking of tea within each eliciting context was observed. Evidence of effects of color type and/or intensity on sensory perception, albeit inconsistent possibly due to a myriad of reasons including differences in specific experimental objectives, approach, stimuli and methods, has been well established (Pangborn 1959; Johnson and Clydesdale 1982; Alley and Alley 1998; Garber and others 2001). Piqueras-Fiszman and Spence (2012) demonstrated a significant effect of the color of the cup on overall liking of a hot beverage, but a nonsignificant effect on sweetness perception. Findings from this study indicates that, although the actual type and intensity of the color of a beverage may affect liking and sweetness perception, information such as sweetener name or its colored packet may exert some influence as well. Despite a lack of statistical significance in acceptability ratings across eliciting conditions, the fact that both sweetness and overall liking of tea changed from "like slightly" to "neither like nor dislike" for sucralose; and overall liking changed from "neither like nor dislike" to "slightly liked" for stevia when moving from control to informed condition, suggests some practical significance of color on sensory perception. Thus yellow triggered less sweetness liking while green elicited better overall liking. Piqueras-Fiszman and others (2012) also observed that, when mousse was served from a white plate, it was perceived as significantly sweeter, and more liked than from a black plate. The white colored sucrose packet may have had a limited impact on the slightly higher ratings of sweetness and overall liking observed in the informed condition than in the control condition.

Variations in the emotion profiles of sweeteners across eliciting conditions and among sweetener types were observed. Due to consumer heterogeneity, it is probable that emotional connotations would vary based on prior associations and expectations. Spinelli and others (2015) explained that, brand and packaging are potentially powerful elicitors of emotions and may contribute to increased liking, but only if this communication is perceived as coherent with the expectations. Overall, a distinct emotional profile of sucrose from that of the sucrose substitutes seem to strongly suggest an influence of familiarity on emotional responses, since sucrose is the standard sweetener to which all others are compared (Leitch and others 2015). Piqueras-Fiszman and Spence (2012) previously suggested that, any effects of color on perceived flavor might be driven by a consumer's familiarity with a certain brand, should it be associated with a particular color. Future research should take into consideration initial preferences for different sweeteners, extent of product familiarity, and consumer attitudes to alternative sweeteners in order to tease out their effects on emotional responses to the sweet taste.

Considering both hedonic and emotions ratings simultaneously in the multivariate space revealed a greater influence of the colored packet than name of the sweeteners. In addition, although sucrose was distinctly separate from nonnutritive sweeteners, their separation was greater in the informed than control condition, highlighting the differentiating impact of the packet image. Correlations among acceptability and emotion ratings showed that, while perceived sweetness liking for sucrose alternatives were similar, their emotion intensities varied, leading to differences in their correlation with emotions. This is in line with previous research that demonstrate unpredictable relationships between liking and emotions (King and Meiselman 2010; Gutjar and others 2015b; Wardy and others 2015).

Further implications of this research extends to its application for potentially altering consumer behavior towards the consumption of sugar and nonnutritive sweeteners. With the increasing global rates of obesity being partially attributed to the increased consumption of added sucrose, modifying an individual's preference for sweet taste in products containing sucrose alternatives may result in a decrease in overall calories consumed. Color although a confounding factor for taste perception, can provide an indication of other product attributes such as calories (Porcherot and others 2013). While significant differences in acceptability and emotion among sucrose alternatives were not observed for either eliciting condition in the present study, their sensory-emotion profiles provided an indication of how close they matched that of sucrose, and specific associations between emotions and liking were observed for the colored sweetener packet. This may inform strategies for the sensory marketing of functional foods targeting reduced caloric intake. Regardless, the need for a deeper understanding of how sweetness correlates with satiety, and other factors contributing to overall caloric intake remains. Future studies examining how color interlaces with other intrinsic and extrinsic product cues to influence perception of high calorie foods, caloric consumption, other high calorie food components, and purchase behavior are therefore needed.

6.5 Conclusions

The impact of sweetener type on acceptability and emotional responses in the name *vs.* name/packet image conditions using equi-sweet tea samples was investigated. Sweetener type exerted a significant effect on sweetness, overall liking, and emotional responses. Consumers perceived a significantly higher sweetness and overall liking for sucrose than nonnutritive sweeteners. Clearly, the colored sweetener packet elicited more differentiating emotions than

sweetener name. Results demonstrated a trend of significantly lower intensity of positive emotions for nonnutritive sweeteners compared to sugar, and *vice versa* for negative emotions except for the emotions worried and free in both eliciting conditions. Sweetness liking was strongly correlated with the emotion satisfied (sucralose, saccharin) only in the name condition, whereas it was strongly correlated with the emotions pleased and satisfied (stevia), disgusted (aspartame) and satisfied (sucrose) only in the name/packet image condition. Essentially, the sensory-emotion profile of sucrose was distinct from that of nonnutritive sweeteners regardless of actual taste of the product. Overall, sweetener name and packet color independently modulated sensory acceptability and emotions, but jointly impacted their sensory-emotion profile.

6.6 References

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CHAPTER 7.
SUMMARY AND CONCLUSIONS

In sensory research, product acceptability (liking) is utilized as a means to understand consumer preferences and purchase decision. However, given commonality of product homogeneity and incidence of market failure of well-liked products, the need to derive a more holistic product and consumer understanding beyond liking in the product development process is necessary. Emotion profiles of foods present an insightful tool for further differentiating among food products, even though it is not clear which aspects provide information separate from liking. Perception of food is a multidimensional experience encompassing extrinsic and intrinsic attributes, value, and nutrition among others which may influence judgment and affective responses. Different product attributes impact satisfaction differently and consumer satisfaction with products warrants that they fulfill or exceed consumer needs and expectations. According to Kano's theory, some product attributes can explain only dissatisfaction (must-be), others explain solely satisfaction (attractive), others explain both satisfaction and dissatisfaction (one-dimensional), others have no impact on satisfaction/dissatisfaction (indifferent) and others may indicate confusion about the product or concept (reverse). The various dimensions of consumer satisfaction may therefore be a key underlying concept influencing consumer emotions and liking. An understanding of the association between attribute performance on consumer satisfaction and emotions elicited by food, and the extent of their respective contributions to product liking, is however lacking.

The objective of this research was therefore to explore the role of cognitive assessments of attribute performance on satisfaction in explaining the association or otherwise between food-

evoked emotions and sensory preferences. In addition, factors influencing the sensory-emotion profile of food products, specifically extrinsic package cues were investigated.

In the first phase of this research, a series of consumer studies were conducted using eggs as a test product. First, the extent to which egg product attributes considered important by consumers to purchase intent and the satisfaction of quality requirements was determined using principal component analysis (PCA) and Kano modeling concepts. The emotional profile of the product was then analyzed in the presence *vs.* absence conditions to evaluate impact of egg quality groupings. Subsequently, the data was analyzed to elucidate relationships between emotions, satisfaction performance measures and product acceptability. In the second phase, the relative effects of package color and labeling cues on sensory acceptability and rated emotional responses to a set of tasted test products were assessed to better understand factors influencing perception.

For phase I, 5 principal components: intrinsic, extrinsic, aesthetic, expedient and wholesome characteristics were extracted from 20 egg attributes influencing purchase decision of eggs, altogether explaining 57.43% of the total variance. From the Kano analysis, 8 variables (freshness, shell cleanness, absence of cracks, USDA-certified farm eggs, label stating 'packing/best-before-date', egg grade, secure packaging and availability) corresponding mostly to extrinsic, expediency and wholesome characteristics were categorized as "must-be attributes" with dissatisfaction coefficients ranging from 0.87 (freshness) to 0.38 (egg grade). Sale price and egg size were classified as one-dimensional and attractive attributes, respectively. Emotion ratings along with hedonic testing revealed significant differences between the emotional profile of highly acceptable wholesome eggs and less acceptable egg products; hence eggs with different quality attributes could be differentiated by emotional data. Attribute absence rather than

presence evoked greater consumer discriminating emotions, and emotions and acceptability were more correlated for attribute absence than presence. However, emotional responses to both presence and absence of intrinsic indifferent Kano attributes were similar, reflecting their dynamic effects on emotions. The benefit of highly rated positive emotions identified for wholesome and expedient attributes, was distinct from the comparative emotional response to the presence and absence of intrinsic, aesthetic, and extrinsic attributes, which could not be clearly differentiated indicating the relative importance of the former to consumer acceptance than the latter. The analysis found that positive and negative dimensions of emotions interact differently with attribute satisfaction performance. The strongest relationship was between positive emotions and Kano must-be and one-dimensional drivers of satisfaction. Negative emotions were found to have very little relationship with different Kano categories of satisfaction.

For phase II, there were significant effects of sweetener type contrary to package color on sweetness liking, overall liking, and emotional responses to identical taste stimuli. Overall differences existed among sweetener types and package color based on ratings of both hedonic and emotional responses, suggesting modulating effects of packet color on sweetener type in the sensory-emotion space. The data indicated that sensory perception and emotions during the consumption experience are related not entirely to the type and concentration of sweetener, but also the color of the packet.

Overall, this study demonstrated that, consideration of the different dimensions of consumer satisfaction, and the degree to which consumer emotional responses vary in the presence *vs.* absence of product quality attributes can influence inferences about importance of attributes of interest. In this investigation, egg product acceptability was found to be more a function of evoked emotions than attribute performance on satisfaction. In addition, additive effects of color

and labeling cues of sweeteners on flavor perception and emotions were found, providing evidence of the impact of visual cues on the sensory-emotion space of food products. Nonetheless, further studies will be needed to extend this research across different food categories in order to support the applicability of the current findings. This study is advantageous to product developers, as it identifies opportunities to better understand consumer needs, and factors influencing the affective space of foods, thereby, designing products destined for success in the marketplace.

APPENDIX A.
LETTERS OF PERMISSION

a. Permission for Published Material in Chapter 3

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APPENDIX B.
IRB APPROVALS

a. Application for Exemption from Institutional Oversight (2011)

LSU AgCenter Institutional Review Board (IRB)
Dr. Michael J. Keenan, Chair
School of Human Ecology
209 Knapp Hall
225-578-1708
mkeenan@agctr.lsu.edu

Application for Exemption from Institutional Oversight

All research projects using living humans as subjects, or samples or data obtained from humans must be approved or exempted in advance by the LSU AgCenter IRB. This form helps the principal investigator determine if a project may be exempted, and is used to request an exemption.

- Applicant, please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the LSU AgCenter IRB. Once the application is completed, please submit the original and one copy to the chair, Dr. Michael J. Keenan, in 209 Knapp Hall.

- A Complete Application Includes All of the Following:
  - (A) The original and a copy of this completed form and a copy of parts B through E.
  - (B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1 & 2)
  - (C) Copies of all instruments and all recruitment material to be used.
    - If this proposal is part of a grant proposal, include a copy of the proposal.
  - (D) The consent form you will use in the study (see part 3 for more information)
  - (E) Beginning January 1, 2009: Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing and handling data, unless already on file with the LSU AgCenter IRB.
    Training link: (http://grants.nih.gov/grants/policy/hs/training.htm)

1) Principal Investigator: Witoon Prinyawiatkul **Rank:** Professor **Student? Y(N)**
Dept: Food Science **Ph:** 8-5188 **E-mail:** wprinya@lsu.edu
2) Co-Investigator(s): please include department, rank, phone and e-mail for each

- If student as principal or co-investigator(s), please identify and name supervising professor in this space

None

3) Project Title: Consumer Acceptance of New Food Products
4) Grant Proposal?(yes or(no) **If Yes, Proposal Number and funding Agency** _____
Also, if Yes, either: **this application completely matches the scope of work in the grant Y/N**__
OR
more IRB applications will be filed later Y/N__
5) Subject pool (e.g. Nutrition Students) LSU Faculty, staff, students, and off-campus consumers

- Circle any "**vulnerable populations**" **to be used:** (children<18, the mentally impaired, pregnant women, the aged, other). Projects with incarcerated persons cannot be exempted.

6) PI signature _____ ****Date** 12/9/2011 (no per signatures)
****I certify that ~~my responses are~~ this application is accurate and complete.** If the project scope or design is later changed I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU AgCenter institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at the LSU AgCenter for three years after completion of the study. If I leave the LSU AgCenter before that time the consent forms should be preserved in the Departmental Office.

Committee Action: Exempted √ Not Exempted____ **IRB#** HE11-29
Reviewer Michael Keenan **Signature** Michael Keenan **Date** 12-14-2011

APPROVED BY
LSU AG CENTER
IRB AS HE11-29
ON 12-14-201

Research Consent Form

I, _____ _____, agree to participate in the research entitled "Consumer Acceptance of New Food Products" which is being conducted by Dr. Witoon Prinyawiwatkul, Professor of the Department of Food Science at Louisiana State University, Agricultural Center, phone number (225) 578-5188.

I understand that participation is entirely voluntary and whether or not I participate will not affect how I am treated on my job. I can withdraw my consent at any time without penalty or loss of benefits to which I am otherwise entitled and have the results of the participation returned to me, removed from the experimental records, or destroyed. Up to 150 consumers will participate in this research. For this particular research, about 15-20 minutes participation will be required for each consumer.

The following points have been explained to me:

1. In any case, it is my responsibility to report prior participation to the investigator any food allergies I may have.

2. The reason for the research is to gather information on sensory acceptability of new food products. The benefit that I may expect from it is a satisfaction that I have contributed to quality improvement of these products.

3. The procedures are as follows: 3-5 coded samples will be placed in front of me, and I will evaluate them by normal standard methods and indicate my evaluation on score sheets. All procedures are standard methods as published by the American Society for Testing and Materials and the Sensory Evaluation Division of the Institute of Food Technologists.

4. Participation entails minimal risk: The only risk which can be envisioned is that of an allergic reaction common food ingredients [red beans, bell pepper, onion, garlic, celery, thyme, cayenne pepper, bay leaf, pork products, rice and rice products, milk and dairy products, wheat flour, tapioca flour, eggs, table sugar, vanilla, sweet potato, salt (sodium chloride) and salt substitute (potassium chloride), and plain unsalted crackers]. However, because it is known to me beforehand that the food to be tested contains common food ingredients, the situation can normally be avoided.

5. The results of this study will not be released in any individual identifiable form without my prior consent unless required by law.

6. The investigator will answer any further questions about the research, either now or during the course of the project.

The study has been discussed with me, and all of my questions have been answered. I understand that additional questions regarding the study should be directed to the investigator listed above. In addition, I understand the research at Louisiana State University, Agricultural Center, which involves human participation, is carried out under the oversight of the Institutional Review Board. Questions or problems regarding these activities should be addressed to Dr. Michael Keenan, Chair of LSU AgCenter IRB, (225) 578-1708. I agree with the terms above and acknowledge.

I have been given a copy of the consent form.

_____ _____

Signature of Investigator Signature of Participant

Witness: _____ Date: _____

b. Application for Exemption from Institutional Oversight (2015)

LSU AgCenter Institutional Review Board (IRB)
Dr. Michael J. Keenan, Chair
School of Human Ecology
209 Knapp Hall
225-578-1708
mkeenan@agctr.lsu.edu

Application for Exemption from Institutional Oversight

All research projects using living humans as subjects, or samples or data obtained from humans must be approved or exempted in advance by the LSU AgCenter IRB. This form helps the principal investigator determine if a project may be exempted, and is used to request an exemption.

- Applicant, please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the LSU AgCenter IRB. Once the application is completed, please submit the original and one copy to the chair, Dr. Michael J. Keenan, in 209 Knapp Hall.

- A Complete Application Includes All of the Following:
  - **(A)** The original and a copy of this completed form and a copy of parts B through E.
  - **(B)** A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1 & 2)
  - **(C)** Copies of all instruments and all recruitment material to be used.
    - If this proposal is part of a grant proposal, include a copy of the proposal.
  - **(D)** The consent form you will use in the study (see part 3 for more information)
  - **(E)** Beginning January 1, 2009: Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing and handling data, unless already on file with the LSU AgCenter IRB.
    Training link: (http://grants.nih.gov/grants/policy/hs/training.htm)

1) Principal Investigator: Witoon Prinyawiwatkul **Rank:** Professor **Student?** No
School of Nutrition and Food Sciences **Ph:** 8-5188
E-mail: wprinyawiwatkul@agcenter.lsu.edu **and** wprinya@lsu.edu

2) Co-Investigator(s): please include department, rank, phone and e-mail for each NONE

- If student as principal or co-investigator(s), please identify and name supervising professor in this space

3) Project Title: Consumer Acceptance and Perception of New and Healthier Food Products
4) Grant Proposal?(yes or no) NO **If Yes, Proposal Number and funding Agency**
Also, if Yes, either: **this application completely matches the scope of work in the grant Y/N**
OR
more IRB applications will be filed later Y/N
5) Subject pool (e.g. Nutrition Students) **LSU Faculty, Staff, Students and off-campus consumers**

- Circle any **"vulnerable populations" to be used:** (children<18, the mentally impaired, pregnant women, the aged, other). Projects with incarcerated persons cannot be exempted. **NONE**

6) PI signature ****Date** 3-12-2015 (no per signatures)
****I certify that my responses are accurate and complete.** If the project scope or design is later changed I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU AgCenter institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at the LSU AgCenter for three years after completion of the study. If I leave the LSU AgCenter before that time the consent forms should be preserved in the Departmental Office.

Committee Action: Exempted Not Exempted ✓ **IRB#** HE15-9
Reviewer Michael Keenan **Signature** Michael Keenan **Date** 3-16-2015

APPENDIX C.
QUESTIONNAIRES FOR CHAPTER 3

a. Chicken Egg Quality, Purchase Intent and Consumer Satisfaction Survey

Participant #: …….. Date:……..

Part I. Demographic information:

Gender: ( ) Female ( ) Male

Age (years): ( ) 18-30 ( ) 31-40 ( ) 41-50 ( ) 51-60 ( ) >60

Race: ( ) Caucasian ( ) Black ( ) Hispanic ( ) Asian

( ) Other _____

Annual Income: ( ) <$10,000 ( ) $10,001-25,000 ( ) $25,001-50,000 ( ) $50,001-75,000

( ) > $75,000

Education: ( ) High school or lower ( ) College ( ) Graduate degree (Masters, Ph.D., etc.)

Part II. Purchase intent of eggs based on important factors

Please check one rank (5 = most important, 4 = very much important, 3 = moderately important, 2 = slightly important, 1 = least important) for each factor affecting your decision to purchase eggs

Factors affecting purchase intent	Ranking				
	1	2	3	4	5
	Least				Most
1. Freshness					
2. Cleanliness of shell					
3. Shell thickness					
4. Cracks on shell					
5. Shell surface smoothness					
6. Glossiness of shell					
7. Shell color (white, brown, etc.)					
8. Spotless eggshell (uniform color)					
9. Shape of egg (more or less oval)					
10. Color of egg yolk (based on prior experience with particular brand)					
11. Egg size					
12. Labeled with ‘‘packing and best before date’’					
13. Egg is fortified with a nutrient (such as omega-3, vitamin E, folate, etc.)					
14. Egg is organic (no usage of hormones, antibiotics)					
15. Eggs originated from a USDA-certified farm					
16. Sale price					
17. Brand availability/loyalty					
18. Desired packaging (styrofoam, cardboard, etc.)					
19. Egg grade displayed on package					
20. Availability (quantity when needed)					

Part III. Satisfaction of consumers to fresh raw eggs

Please check one answer that best reflects how you feel about the following egg attributes.

Attribute	Answer	Attribute	Answer
1. Egg is fresh	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	2. Eggshell is clean	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
3. Eggshell is thick	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	4. Eggshell has no visible cracks	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
5. Eggshell has smooth surface	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	6. Eggshell is glossy	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
7. Eggshells are white	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	8. Spotless eggshell (such as uniform white color)	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
9. Eggs have a uniform oval shape	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	10. Egg yolk has a darker orange or yellow color	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it

Attribute	Answer	Attribute	Answer
11. Whole egg is large or extra-large in size	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	12. Package label states ''packing or best before date''	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
13. Eggs are nutritionally enhanced with Omega-3, Vitamin E, Folate, etc.	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	14. Labeled as organic egg	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
15. Label states that eggs are from a USDA-certified farm	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	16. Sale price is reasonable	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
17. Package label indicates brand	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	18. Eggs are packaged securely in styrofoam, plastic or paper cartons	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
19. Package label displays egg grade (such as AA, A, B)	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	20. Eggs are available (both amount and when needed)	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it

Please check one answer that best reflects how you feel about the following egg attributes.

Attribute	Answer	Attribute	Answer
1. Eggshell is dirty	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	2. Eggshell is not white (such as brown)	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
3. Eggshell has some visible cracks	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	4. Whole egg is small in size	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
5. Eggshell has a rough surface	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	6. Eggs don't have a uniform oval shape	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
7. Eggshell is not glossy	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	8. Color patches in eggshell (such as uneven white color)	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
9. Egg is old or not fresh	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	10. Eggs are not nutritionally enhanced with Omega-3, Vitamin E, Folate, etc.	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it
11. Package label does not indicate brand	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it	12. Eggs are not packaged securely such as no lid, etc.	( ) I like it ( ) I expect it ( ) I'm neutral ( ) I can tolerate it ( ) I dislike it

Attribute	Answer	Attribute	Answer
13. Package label does not state ‘‘packing and best before date’’	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it	14. Not labeled as organic egg	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it
15. Label does not state eggs are from a USDA-certified farm	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it	16. Package label does not display egg grade (such as AA, A, B)	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it
17. Eggs are scarce (not enough quantity when needed)	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it	18. Sale price is high	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it
19. Egg yolk has a light orange or yellow color	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it	20. Eggshell is thin	( ) I like it ( ) I expect it ( ) I’m neutral ( ) I can tolerate it ( ) I dislike it

APPENDIX D.
QUESTIONNAIRES FOR CHAPTER 4

a. Consumer Emotions and Chicken Egg Quality Survey

Part I. Demographic Information

1. Gender: [ ] Female [ ] Male

2. Age (years): [ ] 18-30 [ ] 31-40 [ ] 41-50 [ ] 51-60 [ ] > 60

3. Ethnicity: [ ] Caucasian [ ] Black [ ] Hispanic [ ] Asian [ ] Other

4. Education: [ ] High school or lower [ ] College [ ] Graduate degree (Masters, Ph.D., etc.)

5. Which of the following best describes your egg purchase frequency? [ ] Seldom [ ] Sometimes [ ] Often [ ] Always

Part II. Consumer emotions to egg quality attributes

1. INTRINSIC egg attributes refers collectively to: 1. organic (no usage of hormones, antibiotics), 2. nutrient-enhanced (e.g., with omega-3, vitamin E, etc.), and 3. USDA-certified farm eggs. Click + to enlarge image

i. How would you rate overall acceptability of eggs having intrinsic quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

ii. How would you rate emotions elicited by PRESENCE OF INTRINSIC egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

Absence of intrinsic egg attributes refers collectively to: 1. Not organic (no usage of hormones, antibiotics), 2. Not enhanced with a nutrient (such as omega-3, vitamin E, etc.), and 3. Not from a USDA-certified farm. Click + to enlarge image

iii. How would you rate overall acceptability of eggs lacking intrinsic quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

iv. How would you rate emotions elicited by ABSENCE OF INTRINSIC egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

2. AESTHETIC egg attributes refers collectively to: 1. white shell color, 2. spotless eggshell (uniform color), and 3. oval egg shape. Click + to enlarge image

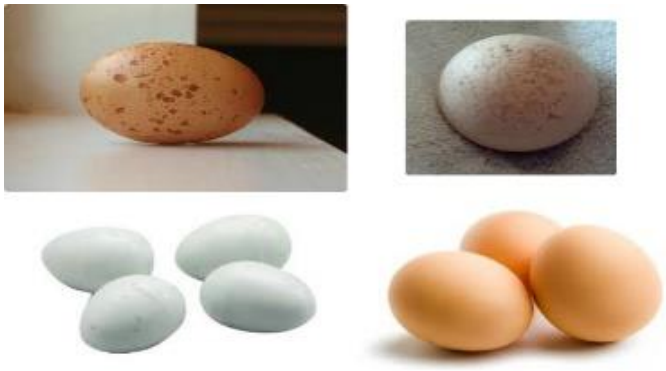
i. How would you rate overall acceptability of eggs having aesthetic quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

ii. How would you rate emotions elicited by PRESENCE OF AESTHETIC egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

Absence of aesthetic egg attributes refers collectively to: 1. brown eggshell, 2. color patches in eggshell, and 3. non-oval egg shape. Click + to enlarge image



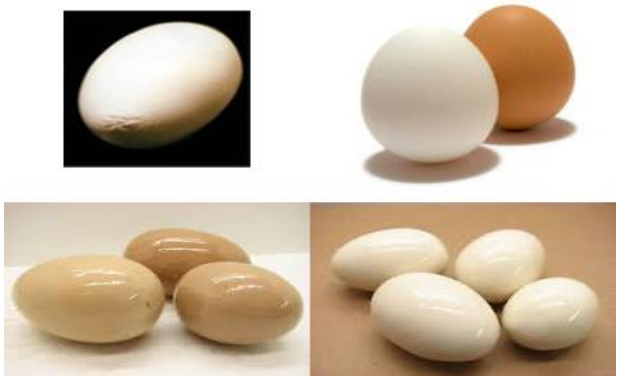
iii. How would you rate overall acceptability of eggs lacking aesthetic quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

iv. How would you rate emotions elicited by ABSENCE OF AESTHETIC egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

3. EXTRINSIC egg attributes refers collectively to: 1. clean eggshell, 2. thick eggshell, 3. smooth eggshell, and 4. desired shell glossiness. Click + to enlarge image



i. How would you rate overall acceptability of eggs having extrinsic quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

ii. How would you rate emotions elicited by PRESENCE OF EXTRINSIC egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

Absence of extrinsic egg attributes refers collectively to: 1. dirty eggshell, 2. thin eggshell, 3. rough shell surface, and 4. undesirable eggshell glossiness. Click + to enlarge image

iii. How would you rate overall acceptability of eggs lacking extrinsic quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

iv. How would you rate emotions elicited by ABSENCE OF EXTRINSIC egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

4. EXPEDIENT egg attributes refers collectively to: 1. large egg size, 2. low sale price, 3. brand displayed, 4. secure packaging, 5. egg grade displayed, and 6. availability (quantity when needed). Click + to enlarge image

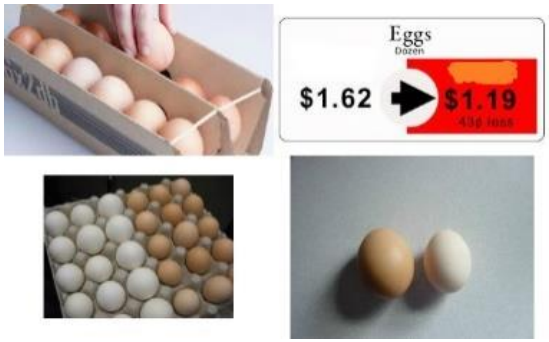
i. How would you rate overall acceptability of eggs having expedient quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

ii. How would you rate emotions elicited by PRESENCE OF EXPEDIENT egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

Absence of expedient egg attributes refers collectively to: 1. small egg size, 2. high sale price, 3. brand not displayed, 4. insecure packaging, 5. egg grade not displayed, and 6. scarce (not enough when needed). Click + to enlarge image



iii. How would you rate overall acceptability of eggs lacking expedient quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

iv. How would you rate emotions elicited by ABSENCE OF EXPEDIENT egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

5. WHOLESOME egg attributes refers collectively to: 1. freshness, 2. absence of cracks, and 3. packing/best-before-date displayed. Click + to enlarge image

i. How would you rate overall acceptability of eggs having wholesome quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

ii. How would you rate emotions elicited by PRESENCE OF WHOLESOME egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

Absence of wholesome egg attributes refers collectively to: 1. not fresh, 2. visible cracks, and 3. packing/best-before-date not displayed. Click + to enlarge image

iii. How would you rate overall acceptability of eggs lacking wholesome quality?

Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
❑	❑	❑	❑	❑	❑	❑	❑	❑

iv. How would you rate emotions elicited by ABSENCE OF WHOLESOME egg attributes?

Emotions	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Active	❑	❑	❑	❑	❑
Adventurous	❑	❑	❑	❑	❑
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Energetic	❑	❑	❑	❑	❑
Friendly	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Interested	❑	❑	❑	❑	❑
Loving	❑	❑	❑	❑	❑
Nostalgic	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Steady	❑	❑	❑	❑	❑
Warm	❑	❑	❑	❑	❑
Whole	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

APPENDIX E.
ADDITIONAL FIGURES FOR CHAPTER 5

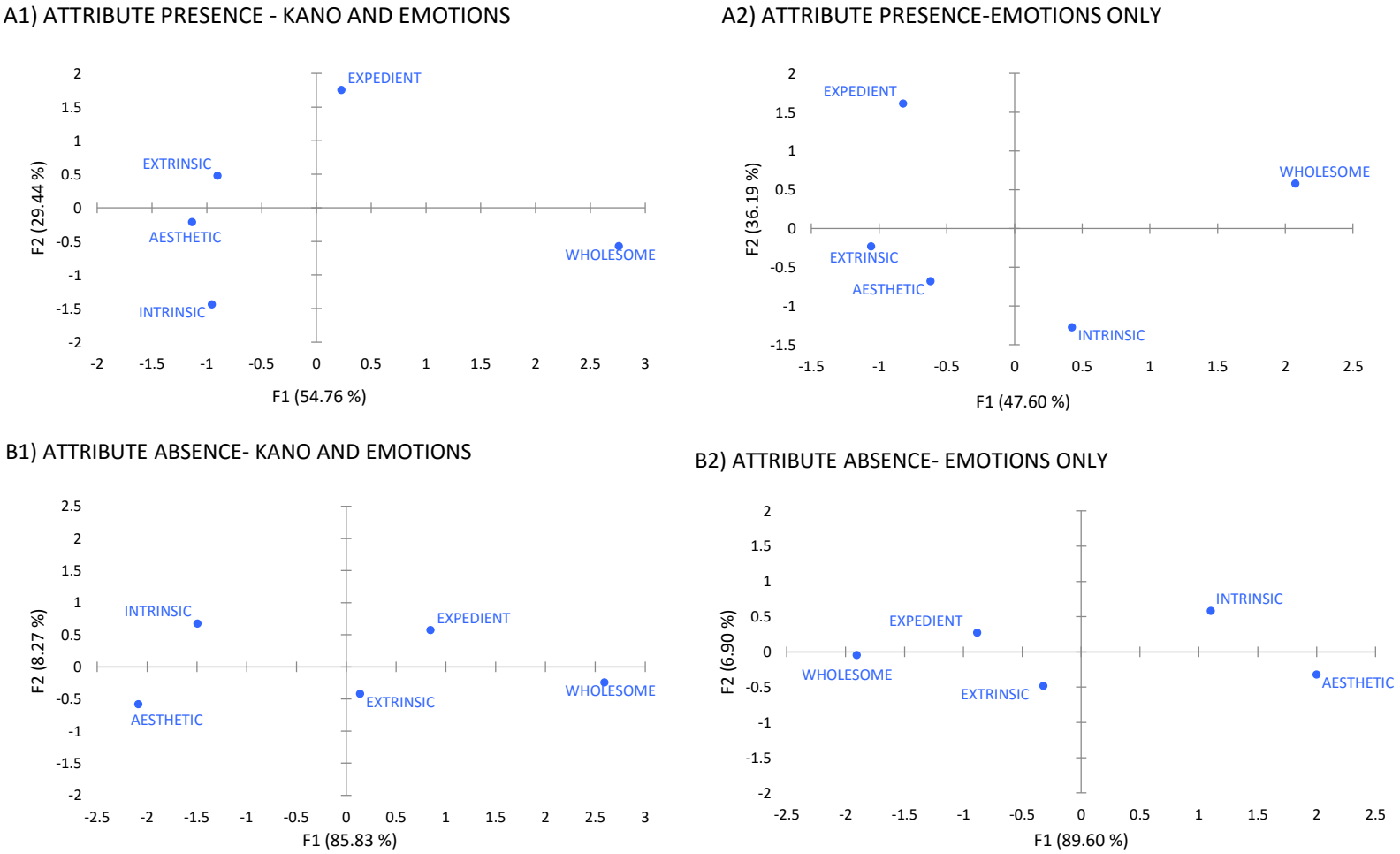
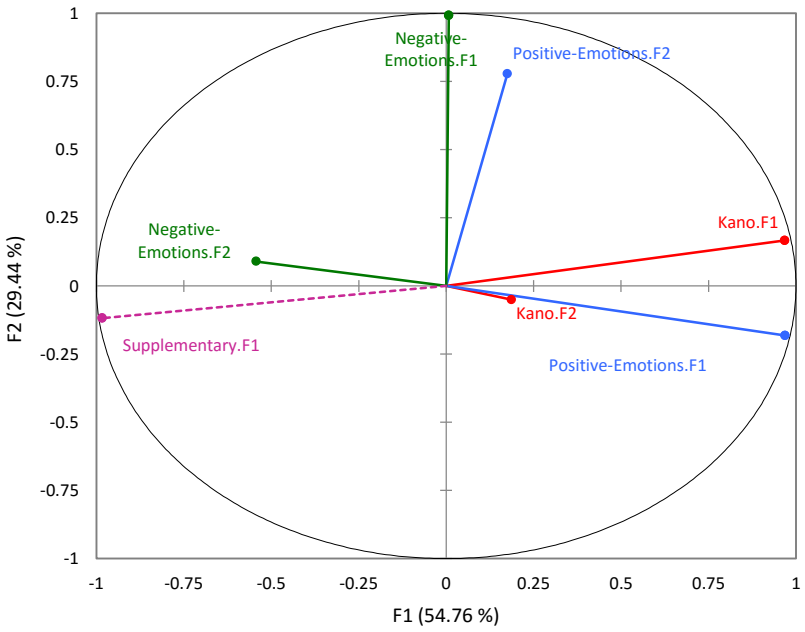


Figure E.1 Multiple factor analysis representation of the 5 egg quality groupings based on emotions, Kano categories and satisfaction/dissatisfaction coefficients for attribute A) presence and B) absence conditions.

A) ATTRIBUTE PRESENCE



B) ATTRIBUTE ABSENCE

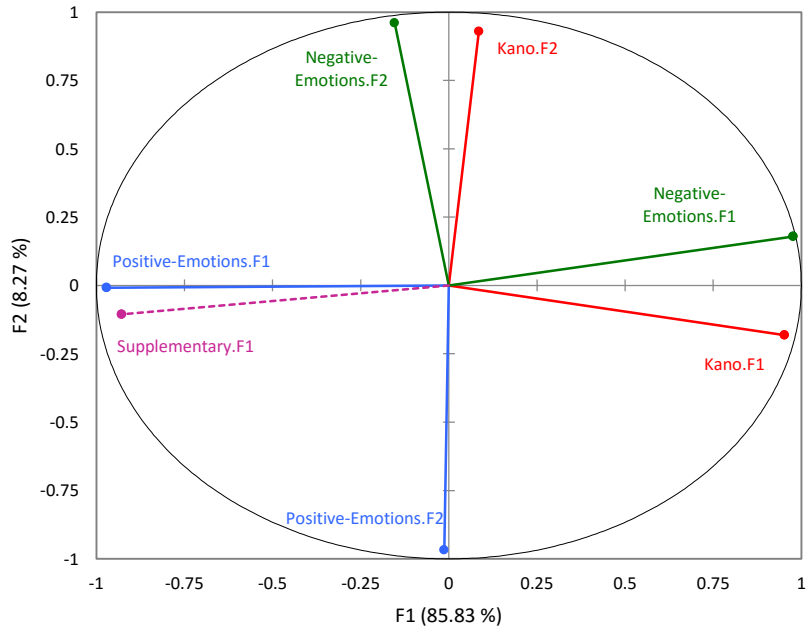
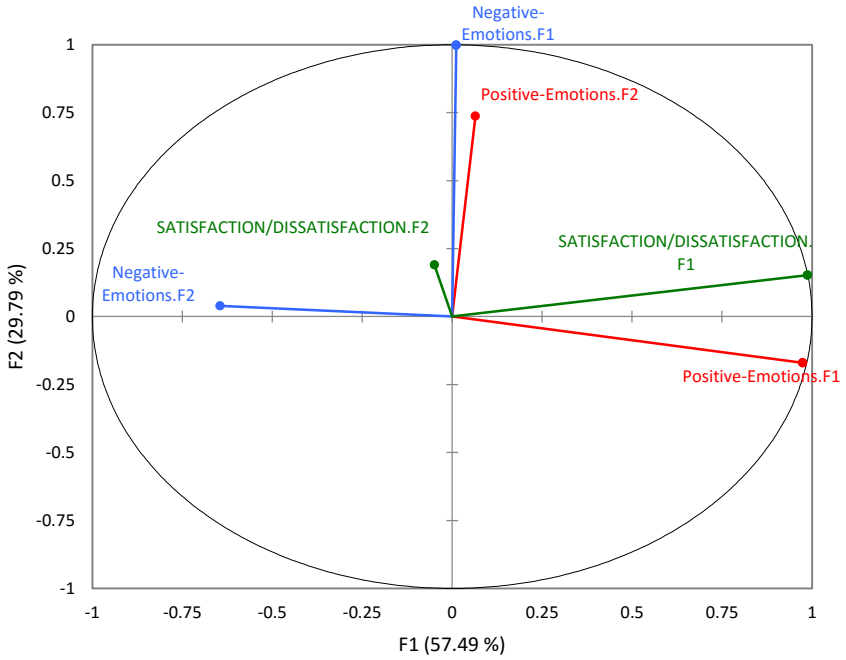


Figure E.2 Representation of the separate analyses {positive emotions, negative emotions and Kano categories (Indifferent Kano attribute = supplementary variable)} on the first and second dimensions of the MFA for (A) attribute presence and (B) absence conditions.

A) ATTRIBUTE PRESENCE



B) ATTRIBUTE ABSENCE

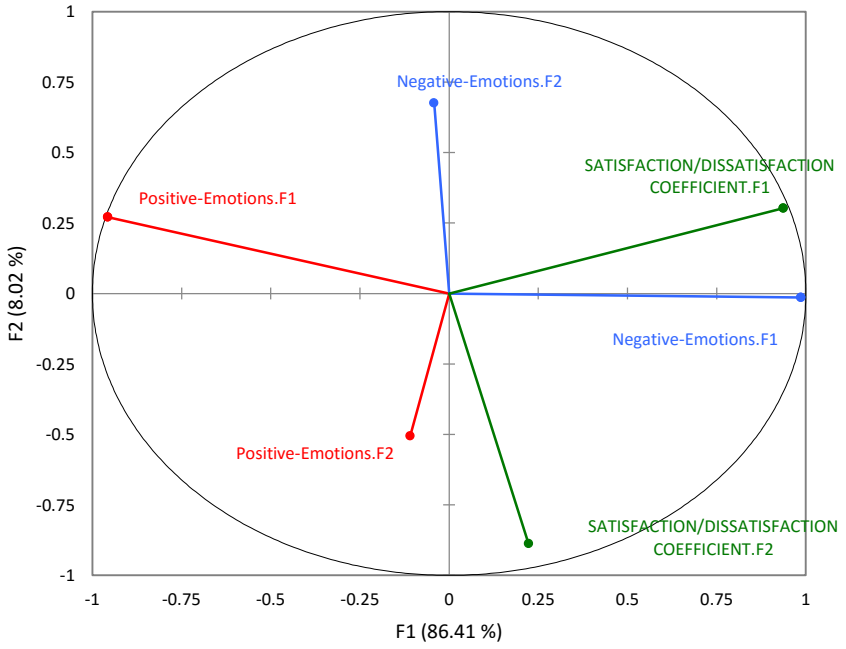
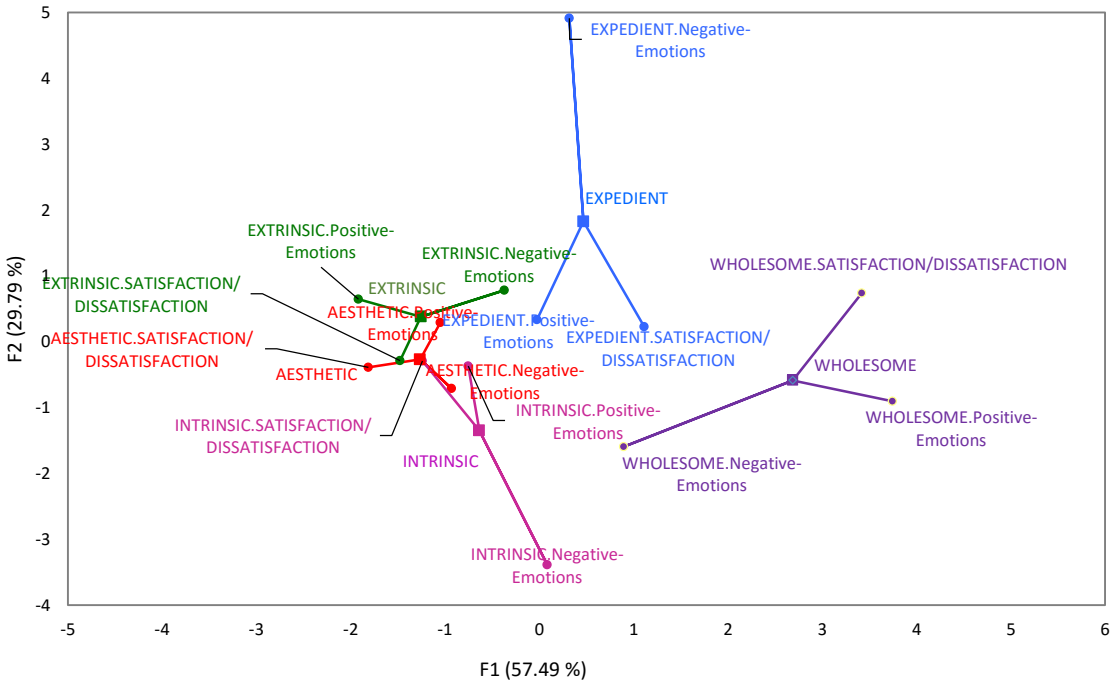


Figure E.3 Representation of the separate analyses (positive emotions, negative emotions and satisfaction/dissatisfaction coefficients) on the first and second dimensions of the MFA for (A) attribute presence and (B) absence conditions.

A) ATTRIBUTE PRESENCE



B) ATTRIBUTE ABSENCE

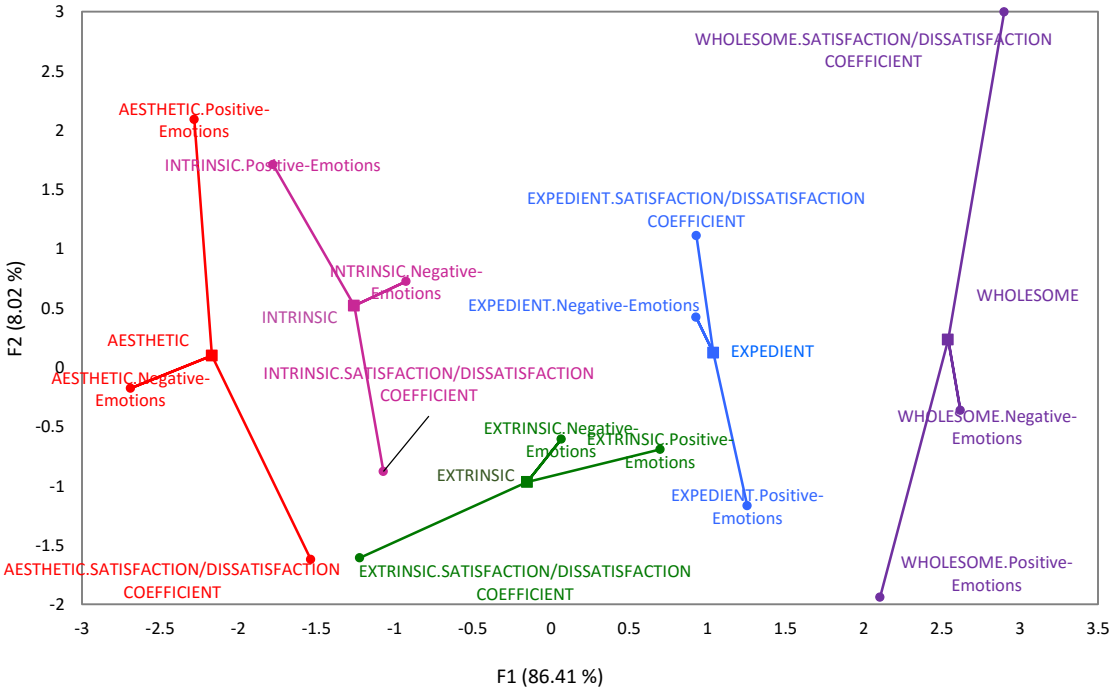


Figure E.4 Multiple factor analysis individual product plots using satisfaction/dissatisfaction coefficients and emotions for (A) attribute presence and (B) absence conditions.

APPENDIX F.
RESEARCH CONSENT FORM, SENSORY AND EMOTION BALLOTS FOR CHAPTER 6

a. Research Consent Form

I, _____, agree to participate in the research entitled "Factors Affecting Consumer Perception of Non-Caloric Sweeteners" which is being conducted by Witoon Prinyawiwatkul of the School of Nutrition and Food Science at Louisiana State University Agricultural Center, (225) 578-5188.

I understand that participation is entirely voluntary and whether or not I participate will not affect how I am treated on my job. I can withdraw my consent at any time without penalty or loss of benefits to which I am otherwise entitled and have the results of the participation returned to me, removed from the experimental records, or destroyed. Two hundred consumers will participate in this research. For this particular research, about 5-10 minute participation will be required for each consumer.
The following points have been explained to me:
1. In any case, it is my responsibility to report prior participation to the investigator any food allergies I may have.
2. The reason for the research is to gather information on factors influencing evaluation of consumer perception and acceptability of foods containing sugar and sugar substitutes. The benefit that I may expect from it is a satisfaction that I have contributed to solution and evaluation of problems relating to such examinations.
3. The procedures are as follows: five coded samples will be placed in front of me, and I will evaluate them by normal standard methods and indicate my evaluation on score sheets. All procedures are standard methods as published by the American Society for Testing and Materials and the Sensory Evaluation Division of the Institute of Food Technologists.
4. Participation entails minimal risk: The only risk may be an allergic reaction to tea, cane sugar and non-caloric sweeteners: aspartame, saccharin, stevia, sucralose. However, because it is known to me beforehand that all those foods and ingredients are to be tested, the situation can normally be avoided.
5. The results of this study will not be released in any individual identifiable form without my prior consent unless required by law.
6. The investigator will answer any further questions about the research, either now or during the course of the project.

The study has been discussed with me, and all of my questions have been answered. I understand that additional questions regarding the study should be directed to the investigator listed above. In addition, I understand the research at Louisiana State University AgCenter that involves human participation is carried out under the oversight of the Institutional Review Board. Questions or problems regarding these activities should be addressed to Dr. Michael Keenan of LSU AgCenter at 578-1708. I agree with the terms above.
Signature of Investigator: _____ Signature of Participant: _____

Witness: _____ Date: _____

a. Sensory and Emotions Testing

Part I. Demographic information

1. Gender [ ] Female [ ] Male
2. Age (years): [ ] 18-30 [ ] 31-40 [ ] 41-50 [ ] 51-60 [ ] >60
3. Race: [ ] Caucasian [ ] Hispanic [ ] Asian [ ] African American
   [ ] Other race ……..
4. Education: [ ] High school or lower [ ] College [ ] Graduate degree
   (Masters, Ph.D., etc.)
5. a) Are you aware of different color packets for different commercially existing sugar substitutes? [ ] Yes [ ] No

b) If yes, please select (√) the packet color for each sugar substitute.

i) Stevia or Truvia [ ] Blue [ ] Yellow [ ] Pink [ ] Green

ii) Sucralose or Splenda [ ] Blue [ ] Yellow [ ] Pink [ ] Green

iii) Aspartame or NutraSweet or Equal [ ] Blue [ ] Yellow [ ] Pink [ ] Green

iv) Saccharin or Sweet'N Low [ ] Blue [ ] Yellow [ ] Pink [ ] Green

6. a) Do you use or consume products containing sugar substitutes?

[ ] Yes, Often [ ] Yes, Sometimes [ ] No

b) If yes, which sugar substitute do you prefer or use regularly? Please rank each sweetener from 1-4 **(1 = like the most, and 4 = like the least**).

Sweetener	Sucralose/ Splenda	Aspartame/NutraSweet/ Equal	Stevia/ Truvia	Saccharin/ Sweet'N Low
Rank				

7. To the best of your knowledge, what are the functions or reasons for the use of sugar substitutes in foods? Select (√) all that apply.

[ ] Nutrition [ ] Health/Disease Prevention [ ] Taste/Flavor [ ] Not sure

8. How would you describe your blood sugar level? [ ] Regular [ ] Low [ ] High [ ] Not sure
9. How much do you **like** iced tea? [ ] Like [ ] Neither like nor dislike [ ] Dislike

Part II. Sample ballot for evaluating sweetness liking, overall liking and emotions in 'control' condition

Instructions:

- Please taste each sample of tea and rate each one according to your own perception.
- Between samples, drink water and eat unsalted cracker to clean your palate!

Sample XXX is sweetened with **REGULAR CANE SUGAR**

1) How would you rate (√) the following attributes of **Sample XXX**.

	Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
Sweetness	❑	❑	❑	❑	❑	❑	❑	❑	❑
Overall liking	❑	❑	❑	❑	❑	❑	❑	❑	❑

2) Please taste **Sample XXX** again. Using the terms listed, please describe how you **FEEL** right now. Please rate (√) each feeling**.**

Sample XXX is sweetened with REGULAR CANE SUGAR

Feeling	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Free	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Pleased	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

Part III. Sample ballot for evaluating sweetness liking, overall liking and emotions in 'informed' condition

Sample XXX is sweetened with **REGULAR CANE SUGAR**

1) How would you rate (√) the following attributes of **Sample XXX**.

	Dislike Extremely [1]	Dislike Very Much [2]	Dislike Moderately [3]	Dislike Slightly [4]	Neither Like Nor Dislike [5]	Like Slightly [6]	Like Moderately [7]	Like Very Much [8]	Like Extremely [9]
Sweetness	❑	❑	❑	❑	❑	❑	❑	❑	❑
Overall liking	❑	❑	❑	❑	❑	❑	❑	❑	❑

2) Please taste **Sample XXX** again. Using the terms listed, please describe how you **FEEL** right now. Please rate (√) each feeling**.**

Sample XXX is sweetened with REGULAR CANE SUGAR

Feeling	Not at all [1]	Slightly [2]	Moderately [3]	Very much [4]	Extremely [5]
Bored	❑	❑	❑	❑	❑
Calm	❑	❑	❑	❑	❑
Disgusted	❑	❑	❑	❑	❑
Free	❑	❑	❑	❑	❑
Good	❑	❑	❑	❑	❑
Guilty	❑	❑	❑	❑	❑
Happy	❑	❑	❑	❑	❑
Peaceful	❑	❑	❑	❑	❑
Pleased	❑	❑	❑	❑	❑
Satisfied	❑	❑	❑	❑	❑
Safe	❑	❑	❑	❑	❑
Worried	❑	❑	❑	❑	❑

VITA

Wisdom Wardy is a native of Dzodze, a town in the Volta Region of Ghana. He received his Bachelor of Science degree in Nutrition and Food Science, and Master of Philosophy degree in Food Science from the University of Ghana, Legon. He spent a year working in Academia and the Food Industry in Ghana after his Bachelors, and also after his Masters, prior to entering the Food Science Ph.D. program at Louisiana State University to study in the area of sensory science. During his graduate studies, he was also involved in conducting research related to seafood by-product utilization focused on the application of antimicrobial edible films/coatings from chitosan for maintaining the quality of food products. Wisdom enjoys spending time with family, travel, reading, writing and playing basketball in his spare time. He expects to graduate with his doctorate in August 2016, after which he plans to pursue a career as a research scientist.