

Article

Coffee Drinking and Emotions: Are There Key Sensory Drivers for Emotions? [†]

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Abstract: In the past couple of decades the coffee market has exploded, and to remain competitive, it is important to identify the key drivers for consumer acceptance of coffee. This study expanded on the previous emotion study on a population of coffee drinkers in Manhattan, Kansas, USA and focused on identifying the sensory drivers of emotional responses elicited during the coffee drinking experience (CDE). A trained coffee panel performed a descriptive analysis of six coffee samples and identified the key sensory attributes that discriminated each coffee. Utilizing Partial Least Square Regression (PLSR), the descriptive data were then mapped with the emotion data to identify sensory drivers for eliciting the emotional responses. The sensory characteristics of dark roast coffee (*roast*—aroma and flavor, *burnt*—aroma and flavor, *bitter*, and *body*) might elicit positive-high energy feelings for this population of coffee users. *Tobacco* (flavor) and *cocoa* (aroma) may also be responsible for positive emotions (*content*, *good*, and *pleasant*). *Citrus* and *acidity* seemed to be negative sensory drivers as they induced the feeling of *off-balance*. Sensory descriptive data could be useful to describe emotion profiles elicited by coffee drinking, which could help the coffee industry create coffee products for different segments of coffee drinkers.

Keywords: descriptive analysis; emotions; coffee

1. Introduction

Human senses are powerful elicitors of emotions and the interactions between the two are rarely debated [1–3]. A number of studies have attempted to define and categorize human emotion, but it is only recently that emotions have been linked to acceptance of food and beverage. Nowadays, there is more awareness that the emotional experiences consumers receive from a product via sensory perception determine acceptability and consumption [4,5]. Therefore, assessment of the emotional responses elicited by the sensorial experience during product consumption is also vital. Several researchers have developed emotion scales to measure the affective feelings evoked by product consumption (EsSense Profile™) [6] or by olfactory stimulations from everyday odors (Geneva Emotion and Odor Scale) [1].

The emotions elicited by the coffee drinking experience were identified in our previous work [7], where they determined a list of 44 emotions suitable for defining the ‘Coffee Drinking Experience (CDE)’ and provided the emotion profiles for each segment of coffee drinkers. The consumers in the study were clustered in six consumer segments. To have a complete understanding of consumers’ perceptions,

it is important to understand the sensory characteristics that elicit those emotions experienced during coffee consumption.

Coffee is well known for its complex sensory characteristics and is often consumed for the sensory experience it provides, in addition to the physiological stimulation of the caffeine [8–11]. Coffee is one of the few food products that utilizes specialized experts (cuppers) to ensure that the sensory properties are up to standard. These experts are not trained sensory assessors but have a lot of experience in determining the quality of coffee for commercial purposes [12]. Trained sensory panels are used extensively for understanding the sensory characteristics of food products including coffee. Bhumiratana et al. [13] conducted a descriptive analysis study on aroma evolution in coffee beans when they are subjected to roasting to different levels of roast. Due to its high complexity, the descriptive sensory panel may need training specifically for coffee, in addition to the usual intensive training program on the sensory characteristics of food and beverage. Many studies support that the amount of training and regular re-training correlate with panelist perception of the sensory attributes and increases the quantification accuracy of attribute intensities [14–17]. Recently, a “living” lexicon for descriptive analysis of brewed coffee was developed by Chambers IV et al. [18] that can be used by sensory researchers for descriptive analysis of coffee.

The link between emotion profiles for a food product and its descriptive sensory profile to understand drivers of positive and negative emotions during consumption has been explored to a limited extent by sensory researchers. Interestingly, the two studies the authors found are on dark chocolates but neither used the classic descriptive approach in their respective study [4,19]. Thomson et al. [4] utilized best–worst scaling to gather sensory information on nine dark chocolates from consumers. They also asked the consumers to identify five emotion descriptors from a pre-conceptualized list that come to their mind for each chocolate. The conceptual biplot between the sensory data and the emotions revealed that the sensory differences in products could drive, in part, conceptual differences due to the emotional response. In another study, Jager et al. [19] reported the link between temporal dominance of sensation (TDS; analytical data) and temporal dominance of emotions (TDE; affective data) using unflavored and flavored dark chocolates. The unflavored dark chocolates (70% and 85% cocoa content) characterized by bitter, dry, and cocoa flavor were linked to *aggressive*, *bored*, *calm*, and *guilty* emotions, while the fruit-flavored dark chocolates (orange and blueberry) that were characterized by crunchy, fruit, and sweet elicited *interested*, *happy*, and *loving* emotions. The fruit-flavored chocolates were liked more by the consumers as was evident through their emotional response as well. The main objective of our study was to identify sensory drivers of emotional response to the experience of coffee drinking. A trained coffee panel performed descriptive analysis on the coffee samples that were used to elicit emotions in coffee drinkers. The sensory data was then utilized to determine the sensory drivers for emotional responses in each segment (cluster) of consumers as reported in Bhumiratana et al. [7].

2. Materials and Methods

2.1. Descriptive Panel

The descriptive coffee panel from the Wolf group (Cincinnati, OH, USA) was utilized to evaluate the coffee samples. The panel consisted of six highly-trained members who had completed 120 h of general training and had a minimum of 1200 h of sensory testing of food and beverages. The coffee panelists also completed an additional 120 h of training on various coffee stimuli and key attributes (coffee, robusta, roasted, burnt, earthy, risty, acidity, bitter, and body). Performance of the panel is evaluated every 3 months in the form of a blind reference sample or samples. This coffee panel has been evaluating coffee products regularly for over 2 years before doing this study.

2.2. Coffee Samples

The six single-serve coffee samples (K-Cup® Keurig, Inc.; Reading, MA, USA) were evaluated by the descriptive sensory panel. These single-serve coffee samples represented the range of roast levels from light to dark. Green Mountain Breakfast Blend represented the light roast. Green Mountain Nantucket Blend represented the blend of medium roasted African and Indonesian beans mixed with some French roast. Green Mountain Sumatra Reserved represented dark roasted organic Sumatra coffee. Tully's Kona represented the blend including the famous Hawaiian coffee from the Kona *Typica varietal*, and was classified as medium roast. Tully's Italian Roast represented a blend of dark roast. Lastly, Newman's Own Organic represented a blend of medium and dark roast organic coffee beans. All coffee samples were stored at room temperature (20 °C) until testing and were used in the study within six weeks of their delivery.

2.3. Descriptive Sensory Analysis

2.3.1. Sample Preparation and Serving

Keurig® Special Edition B60 Brewing System (Keurig®, Inc.; Reading, MA, USA) was used to brew the single-serve K-Cup® coffee samples. The machine was set up and cleaned following the instructions in the user manual. A K-Cup was placed in the K-Cup holder and 157.5 mL of coffee was brewed into a styrofoam cup (Dart J-cup, Dart Container Corp.; Mason, OH, USA). The coffee cups were labeled with 3-digit random numbers prior to serving. After each brewing cycle was completed, the K-Cup was removed and discarded immediately. Each coffee cup was covered with either a saucer (Econo Rim, Syracuse China; Lyncourt, NY, USA) or a plastic lid (Dart Container Corp.; Mason, OH, USA) and was then served immediately to the panelists monadically in random order.

2.3.2. Sample Evaluation

A 180 min orientation session was completed to familiarize the descriptive panel with the samples. During orientation, the panel identified and defined aroma, flavor, and texture attributes present in each sample (Table 1). Necessary references were determined to anchor and calibrate the intensity measurement on a 0 to 15-point scale with 0.5 increments (0.0 = none; 15.0 = extremely high intensity).

Table 1. The list of aroma, flavor, and texture descriptors identified by the coffee panel.

Attributes.	Definitions
Coffee	Amount or strength of Arabica coffee aroma or flavor
Roast	Degree to which the coffee is roasted; ranges from green/no roast–low–medium–dark–very dark
Burnt	Aromatics associated with blacked/acrid carbohydrates (e.g., burnt toast, espresso coffee)
Rioy	Aromatic associated with iodine in water; is described as chlorine-like, brassy, metallic, and chemical
Ashy	Bark-like lingering aromatics associated with a cold campfire
Acidity	A sour, sharp, puckering sensation in the mouth caused by acids
Tobacco	Characteristic reminiscent of tobacco's odor and taste, but should not be used for burnt tobacco
Stale	Not fresh, flat, bodied down or reduced; old
Citrus	Aromatics associated with citrus fruits (e.g., lemon)
Cocoa	Brown, sweet, dusty often bitter aromatics associated with cocoa beans and powered cocoa
Bitter	The amount of bitter basic taste; (e.g., caffeine solutions)
Body (Mouthfeel)	Viscosity of the coffee; heaviness on the tongue: thin to thick

Outlined in the following paragraph is the structured tasting protocol: Once the coffee was served, panelists opened the lid and the temperature of the coffee was taken with a digital thermometer (Model T220/38A Latte Thermometer, Comark; Hertfordshire, UK). When the temperature reached

65.5 °C, the lid was replaced, keeping one end slightly opened. The panelists took a sniff to identify aroma descriptors belonging to that particular coffee. Panelists then slurped the sample and gently manipulated it in the mouth for 10–20 s to evaluate flavor and body/mouthfeel attributes. A small amount of sample was swallowed to discern bitterness on the back of the tongue. Afterward samples were expectorated. A 10 min break was taken between each sample, during which buttered bread and distilled water were used as palate cleansers. Buttered bread was prepared by spreading Land O'Lakes Whipped Butter (Whipped Butter Sweet Cream, Salted, 45% less fat, Land O'Lakes, Inc.; Arden Hills, MN, USA) on a $\frac{3}{4}$ cm slice of European Batard bread (Kroger; Cincinnati, OH, USA).

During testing, panelists evaluated four samples per 180 min panel session. Samples were served one at a time and tasted individually by each panelist. A group discussion was then initiated by a panel leader to determine attributes present, their strengths, and to identify which references were needed. A new cup of the same sample was then served, along with references. The panel then individually evaluated the sample on ballots. The ratings were collected and written on the board by the panel leader. This was to identify any problem areas and whether other references should be reviewed. The panelists then determined and recorded their final score for the first replication of the sample. The next sample was served after a 10 min break and was evaluated following the same procedure. Two replications were carried out for the entire descriptive study.

2.4. Emotion Data

The emotion data for the coffee samples were collected from 94 coffee drinkers (consumers) as reported in Bhumiratana et al. [7]. The consumers were between the ages of 18–70 years and there were 63 female and 31 male participants. In brief, the emotion profile data for each of the six coffees for the 44 terms in CDE (Appendix A) were used. Intensity of emotion elicited by the coffee drinking experience were measured before and during consumption using a 5-point numerical scale (1 = not at all; 2 = slightly; 3 = moderately; 4 = very much; 5 = extremely). The emotion ratings prior to the coffee evaluation were subtracted from the emotion ratings during the evaluation before analyzing the data. Hierarchical cluster analysis (HCA) using Ward's method was carried out on the overall liking data of the six coffee samples. The emotion profiles for each coffee were then separated for the six consumer clusters (Appendix B) and were used in this study. Appendix B also shows the mean liking scores for the coffee samples for each cluster.

2.5. Statistical Analyses

Randomized complete block design was used for the descriptive evaluation of the six coffee samples. A two-way Analysis of Variance (ANOVA) using the GLIMMIX procedure (SAS® system version 9.2; SAS institute; Cary, NC, USA) at a 5% level of significance was performed on the data set to determine attributes significant in identifying differences among products. Coffee sample was the fixed effect and panelist was set as a random effect. Post-hoc mean separation was carried out by using Fisher's Least Significant Difference. Principal component analysis (XLSTAT Sensory 19.01; Addinsoft, NY, USA) with covariance matrix was performed on the sensory descriptors to understand the sensory profile of the coffee samples.

To investigate the relationship between the sensory attributes and the emotional responses to the drinking experience, partial least squares regression (XLSTAT Sensory 19.01) was conducted. Sensory drivers associated with the emotional experiences were identified among the 94 coffee users and in each consumer cluster.

3. Results and Discussion

3.1. Descriptive Sensory Data

The ANOVA followed by mean separation indicated significant differences among the six coffee samples (p -value < 0.05) as shown in Table 2. The coffee descriptive panel differentiated sensory

elements that were distinctive to each coffee sample. *Ashy* was identified in Nantucket and Sumatra and was perceived to be more intense in Nantucket (a medium roast). *Rioy* was detected at the same intensity level in Nantucket, Newman, and Sumatra, but was not present in the other samples. *Tobacco* appeared in the Italian sample, *stale* underlined Newman, and *cocoa* aroma was unique to Kona.

Table 2. The mean scores of the descriptive analysis of the coffee samples.

Descriptors	Abbreviation for Figures	Breakfast	Italian	Kona	Nantucket	Newman	Sumatra
Aroma							
Coffee	CoffeeA	7.79 ^{ab}	5.42 ^c	8.33 ^a	8.58 ^a	7.50 ^{ab}	8.58 ^a
Roast	RoastA	6.92 ^b	8.50 ^a	7.42 ^b	8.50 ^a	7.58 ^b	8.58 ^a
Burnt	BurntA	0.67 ^c	4.50 ^a	0.17 ^c	2.92 ^b	2.83 ^b	4.33 ^a
Rioy	RioyA	0.00 ^b	0.00 ^b	0.00 ^b	1.33 ^a	1.58 ^a	1.58 ^a
Ashy	AshyA	0.00 ^b	0.00 ^b	0.00 ^b	2.75 ^a	0.00 ^b	1.92 ^a
Cocoa	CocoaA	0.00 ^b	0.00 ^b	2.33 ^a	0.00 ^b	0.00 ^b	0.00 ^b
Flavor							
Coffee	CoffeeF	8.25 ^c	8.00 ^c	11.75 ^a	10.33 ^b	11.75 ^a	12.50 ^a
Roast	RoastF	7.08 ^c	10.17 ^a	8.54 ^b	8.92 ^b	10.50 ^a	10.08 ^a
Burnt	BurntF	1.58 ^d	6.67 ^b	6.75 ^b	3.75 ^c	8.33 ^a	8.50 ^a
Rioy	RioyF	0.00 ^b	0.00 ^b	0.00 ^b	2.04 ^a	2.00 ^a	1.58 ^a
Ashy	AshyF	0.00 ^b	0.00 ^b	0.00 ^b	2.92 ^a	0.00 ^b	2.83 ^a
Citrus	Citrus	4.42 ^a	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b
Tobacco	Tobacco	0.00 ^b	8.08 ^a	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b
Stale	Stale	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b	4.42 ^a	0.00 ^b
Acidity	Acidity	5.92 ^a	4.83 ^c	5.83 ^{ab}	5.92 ^a	4.92 ^c	4.92 ^c
Bitter	Bitter	3.08 ^d	9.50 ^a	8.13 ^b	5.42 ^c	8.00 ^b	8.42 ^b
Texture							
Body	Body	6.38 ^d	8.67 ^{ab}	8.33 ^b	7.63 ^c	9.13 ^a	8.83 ^{ab}

^{a,b,c} Row means with common superscripts are not significantly different at $p > 0.05$.

Principal component analysis (PCA) was performed to visualize the product placements on the sensory space based on the sensory attributes. Figure 1 illustrates sensory profiles of the coffees created by the coffee panel in the PCA biplot.

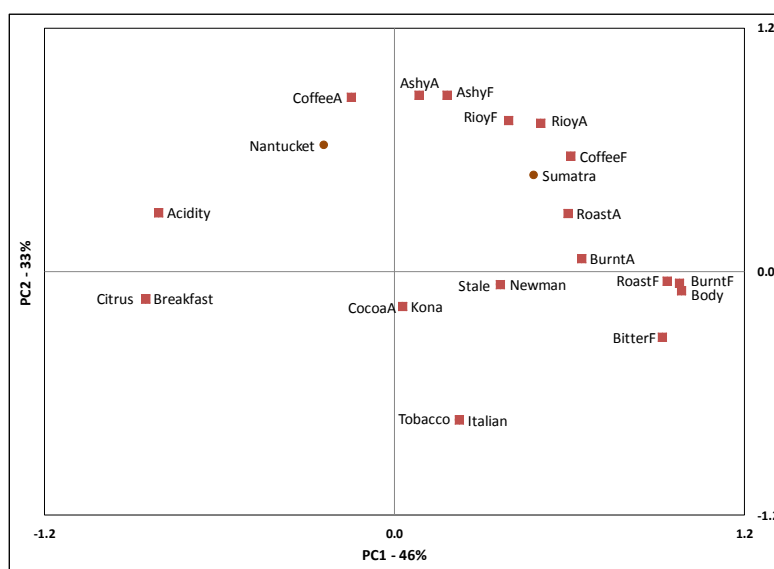


Figure 1. Principal component analysis (PCA) biplot of the sensory profiles of the six coffees generated by the coffee panel.

PC1 explained 46% of the data variation and seemed to reflect characteristics generated by roasting. *Acidity* and *citrus* anchored the left side of PC1 and described Breakfast. *Burnt*, *roast*, *bitter* flavors and *body* anchored the right side of PC1 and seemed to characterize Newman and Sumatra. *Acidity*, *bitter*, *burnt* (flavor and aroma), *roast* flavor, *coffee* flavor (except for Italian) and *body* were influenced by degree of roasting. *Acidity* was more intense in the lighter roasts, while *bitter*, *burnt* (flavor and aroma), *roast*, and *coffee* flavors, and *body* increased with degree of roasting. The impact of degree of roasting on aroma and flavor in coffee has been extensively studied [11,13,20–22] and is similar to what was found in this research. However, degree of roasting was not the only factor affecting the sensory characteristics of coffee. PC2 explained 33% of the data set and provided additional information on sensory elements for Nantucket, Kona, and Italian. *Coffee* aroma and *roast* aroma did not seem to be dependent on roast level. The intensities of these aroma attributes for Nantucket (medium roast) were higher than Newman (medium-dark roast). The sensory profiles indicated some sensory attributes might be independent of degree of roasting, which confirmed that other factors might be influencing the sensory characteristics of coffee. The origins of coffee, including growing regions and variety of bean, evidently have a noticeable impact on the sensory fingerprint of each coffee; this is supported by numerous studies [11,13,23–26].

The sensory data from the descriptive panel was then utilized in the next step to identify the sensory drivers responsible for the emotional responses elicited by the coffee drinking experience.

3.2. Identifying Sensory Drivers for the Emotional Experience

The sensory descriptive data was studied with emotion responses for the same set of coffee samples created by 94 coffee drinkers in the study done previously by Bhuniratana et al. [7]. Partial Least Square Regression (PLSR) was used to identify sensory drivers of the emotion responses (Figure 2). *Coffee* aroma, surprisingly, elicited a range of negative emotions (*bored*, *disgusted*, *annoyed*, and *disappointed*) even though it is well known that ‘coffee aroma’ elicits positive feelings, including alertness of the mental state, and is the driver of coffee consumption [11,27]. This may be because the definition of *coffee* aroma used by the coffee panel and consumers could be different, a common problem in the field of consumer research when integrating sensory and consumer data together. *Coffee* aroma, by the definition listed in Table 1, was the aroma of pure Arabica beans, which consumers may not be familiar with and might have led to a negative perception [5].

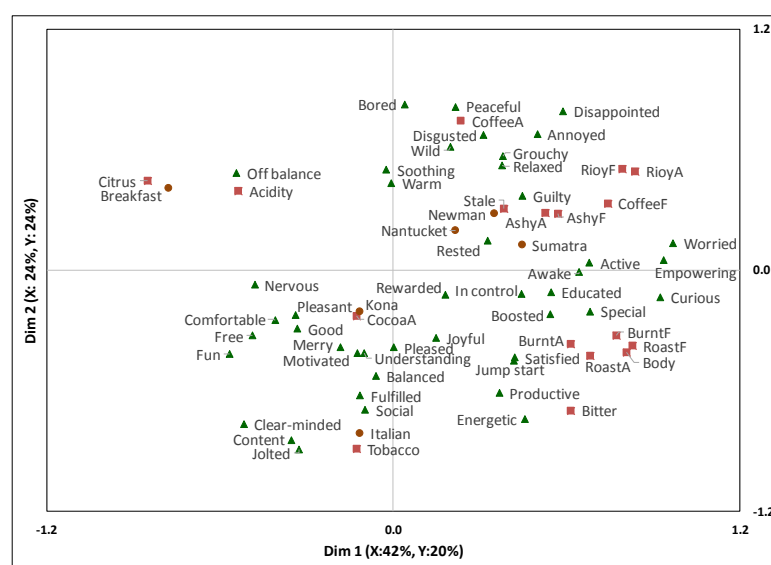


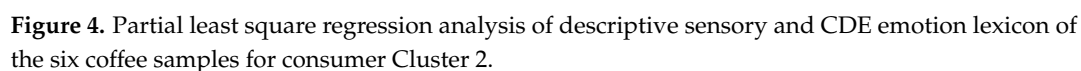
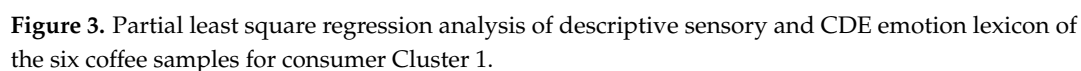
Figure 2. Partial least square regression analysis of descriptive sensory and CDE emotion lexicon of the six coffee samples for 94 consumers.

Positive emotions seemed to be driven by *cocoa* aroma, *bitter*, *tobacco*, *roast*, *burnt*, and *body*. *Cocoa* aroma may elevate *good* and *pleasant* emotions, which was consistent with previous studies. King and Meiselman [6] found that among the five food categories evaluated, chocolate was reported to have the highest ratings for 15 of the positive emotions (out of 24 positive emotions on a list of 39 terms). Macht and Mueller [28] reported consumption of chocolate could immediately reduce negative mood state, although the effect was temporary. It is also common knowledge that chocolate and its resemblance usually induces positive feelings in the general population. *Tobacco* flavor evoked the feelings of *jolted* and *content*. Coffee users may initially be surprised (i.e., *jolted*) by the unfamiliar *tobacco* attribute that was not commonly found in all coffee (only one coffee sample in this study exhibited this sensory attribute). However, they were accepting of the experience (i.e., *content*), which indicates that having a *tobacco* attribute in coffee could potentially enhance the drinking experience for general coffee users. *Bitter* aroused *energetic* and *productive* feelings. *Roast* and *burnt* (flavor and aroma), and *body* texture made consumers feel *jump start*, *satisfied*, *boosted*, and *special*. On the contrary, *citrus*, *hay-like*, and *acidity* appeared to elicit a feeling of *off-balance*. Like *tobacco*, consumers may not be familiar with experiencing these sensory characteristics in coffee and were caught off-guard by them. Unlike *tobacco*, they may not find these attributes appropriate for coffee, hence the *off-balance* emotion. Because emotions are context specific [29], it seems that *citrus* and *acidity* attributes may not fit well with the concept of coffee, which caused negative feelings to develop.

It seems the characteristics of dark roast coffee (*roasted*, *burnt*, *bitter*, and *body*) elicited positive-high energy feelings. This is likely because there were more participants who preferred darker roasts since coffee preference was not one of the criteria during recruitment. This finding identified *tobacco*, *roasted*, *burnt*, *bitter*, and *body* as the sensory drivers for this population of 94 coffee users. Since consumers have varying preferences and are affected differently by sensory stimuli, the 94 coffee users were examined more closely in our previous study [7] through clustering the consumers in six segments. The entire set of 94 coffee drinkers was clustered into six groups based on their acceptability scores for the coffee samples and emotion profiles were generated for each set of consumers. We conducted PLSR analysis on each consumer cluster to determine whether relationships can be drawn between the sensory characteristics and emotions elicited by the perceived attributes for each consumer cluster.

For coffee drinkers in Cluster 1 ($n = 20$), who liked all the coffees [7], the *tobacco* attribute seemed to elicit *social*, *jump start*, and *special* feelings, while the characteristics of dark roasts (high intensity of *roast*, *burnt*, and *body/mouthfeel*) appeared to make them feel *empowering* and *relaxed* (Figure 3). *Acidity* was associated with *awake* and *disgusted* and may be a negative attribute for this group. Cluster 2 ($n = 17$; Figure 4) consisted of consumers who dislike Breakfast (classified as light roast) [7]. The PLSR map indicated that attributes *citrus* and *acidity* elicited negative emotions (e.g., *disappointed*, *disgusted*, *annoyed*), and dark roast characteristics (*roast*, *burnt*, *bitter*, and *body*) were driving positive emotions (e.g., *satisfied*, *energetic*, *rewarded*, *boosted*, *in control*, *empowering*). This group of coffee drinkers seem to relate the *coffee* aroma to a *grouchy* emotion and the *tobacco* attribute to *clear-minded*, *wild*, and *good* feelings.

Cluster 3 ($n = 24$) was identified to like Nantucket and Breakfast but dislike Sumatra [7]. The PLSR bi-plot (Figure 5) illustrated that *hay-like*, *citrus*, and *acidity* brought out positive emotions (e.g., *merry*, *pleasant*, *understanding*, *relaxed*, *rewarded*) for this group of coffee drinkers. *Empowering* and *boosted* emotions seemed to be induced by *coffee* flavor, *ashy*, and *rioy*, while *tobacco* elicited feelings of *off-balance*, *jolted*, and *social*. Negative emotions (*disappointed* and *disgusted*) were driven by *roast*, *burnt*, and *body* characteristics. Coffee drinkers grouped into Cluster 4 ($n = 13$) were those that did not prefer any of the six coffees [7]. Nantucket was liked the most by this group, and that might be the reason that *peaceful*, *energetic*, *pleased*, and *awake* are somewhat encircling this sample in Figure 6. Since they did not have any firm preferences, the coffees may have elicited mixed emotions for this group (Figure 6), which are not easily discernible.



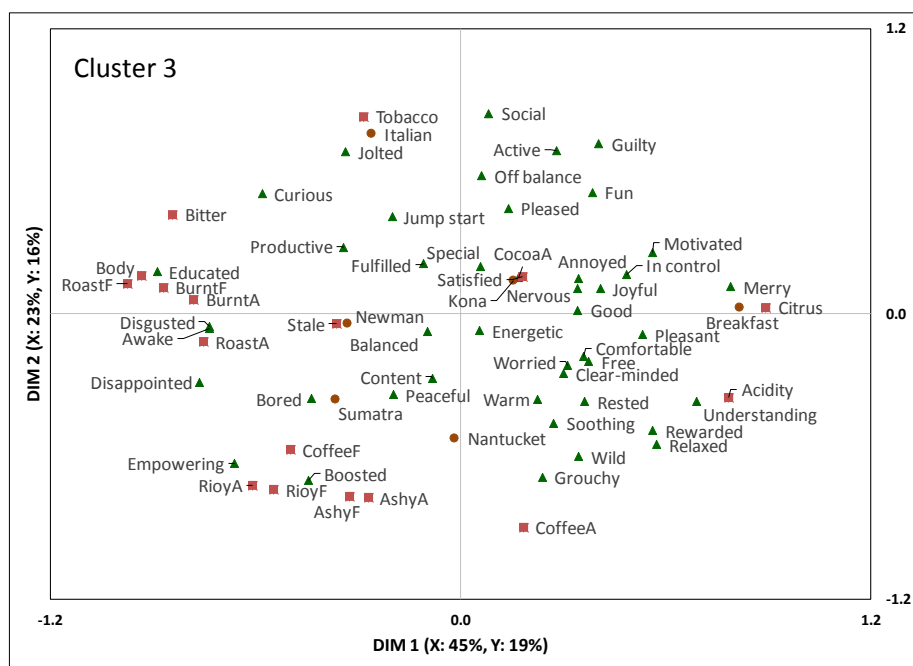


Figure 5. Partial least square regression analysis of descriptive sensory and CDE emotion lexicon of the six coffee samples for consumer Cluster 3.

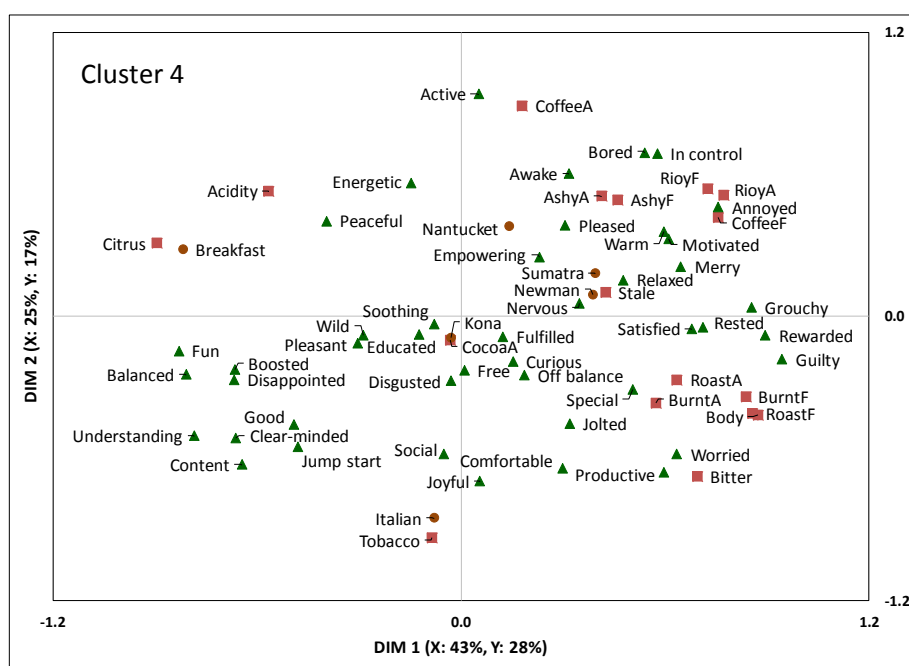


Figure 6. Partial least square regression analysis of descriptive sensory and CDE emotion lexicon of the six coffee samples for consumer Cluster 4.

Cluster 5 ($n = 10$) was composed of coffee drinkers who gave a high liking rating for Breakfast and disliked the dark roasts (Newman, Italian, and Sumatra) [7]. *Citrus* and *acidity* were shown to explain positive emotions (e.g., *relaxed*, *soothing*, *understanding*, *peaceful*), and *coffee* aroma explained *fun*, *rewarded*, and *pleased* (Figure 7). On the other hand, *coffee* flavor and *rioy* appeared to describe negative emotions, including *nervous*, *disgusted*, and *annoyed*. Coffee drinkers in Cluster 6 ($n = 10$) were classified as preferring Kona coffee [7]. The PLSR bi-plot (Figure 8) reflects that this group of consumers were attracted to the *cocoa* aroma as most positive emotions (i.e., *balanced*, *productive*, *fulfilled*,

awake, motivated, and energetic). Tobacco also described good and soothing emotions, while acidity seemed to generate mixed emotions of rewarded, free, jolted, and nervous.

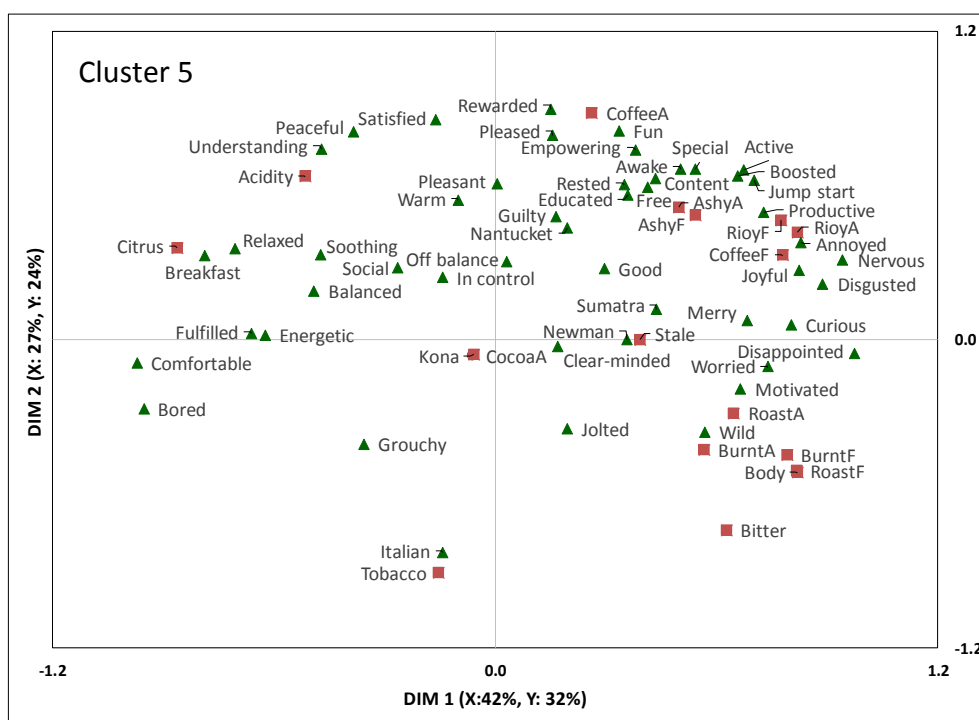


Figure 7. Partial least square regression analysis of descriptive sensory and CDE emotion lexicon of the six coffee samples for consumer Cluster 5.

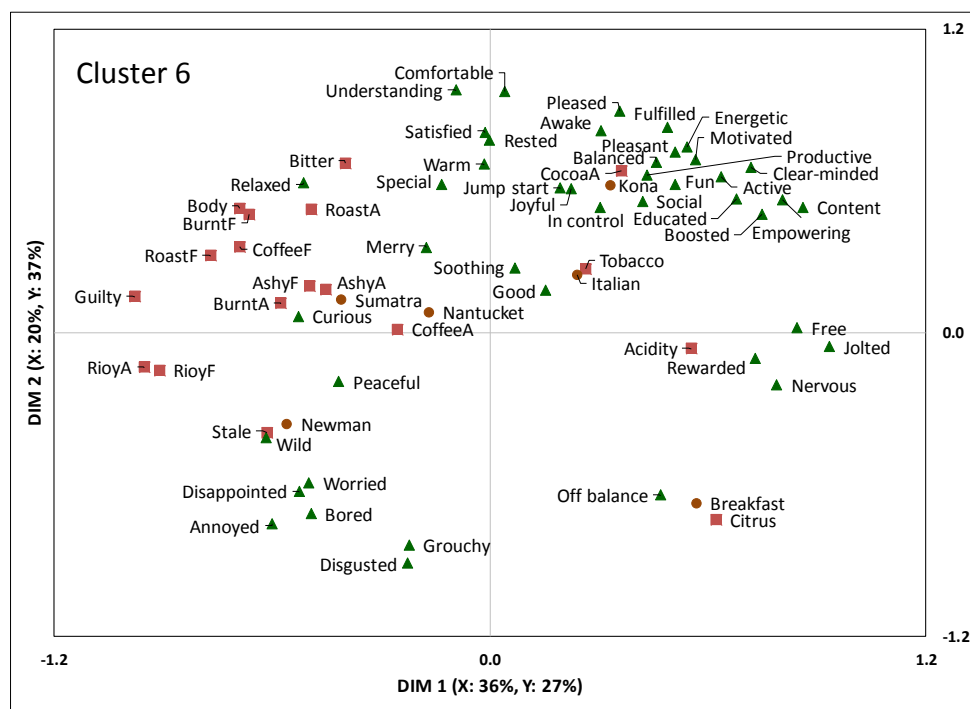


Figure 8. Partial least square regression analysis of descriptive sensory and CDE emotion lexicon of the six coffee samples for consumer Cluster 6.

This study presented the useful interaction of sensory and emotion data. Using the emotion profiles generated by the 44 emotions on the coffee drinking experience lexicon, we were able to identify some sensory drivers for specific emotions elicited by coffee drinking.

4. Conclusions

The PLSR maps indicated that sensory descriptive data might be used to describe emotions profiles elicited by coffee drinking. The PLSR maps were used to identify which attributes had an impact on positive or negative emotional responses from various groups of coffee drinkers. In general, *coffee* aroma, *citrus*, and *acidity* elicited negative feelings while *cocoa* aroma, *tobacco*, *bitter*, *roast*, *burnt*, and *body* generated positive emotions. As consumers have differing likes and dislikes, this study also examined each consumer cluster based on their preferences and identified sensory drivers for the emotions experienced by each cluster. These insights generated by the interaction of sensory and emotion data are valuable to both marketers and product developers by explaining acceptability data and change in consumption or purchase behavior.

Author Contributions: N.B. conceptualized and designed the study with the help of K.A. and E.C.I.; N.B. ran the descriptive analysis under the guidance of M.W.; The data analysis and manuscript preparation were done by N.B. with the help of K.A. and E.C.I.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

The emotion lexicon for Coffee Drinking Experience (CDE) [7].

Active	Disgusted	Jolted	Relaxed
Annoyed	Educated	Joyful	Rested
Awake	Empowering	Jumpstart	Rewarded
Balanced	Energetic	Merry	Satisfied
Boosted	Free	Motivated	Social
Bored	Fulfilling	Nervous	Soothing
Clear-minded	Fun	Off-balance	Special
Comfortable	Good	Peaceful	Understanding
Content	Grouchy	Pleasant	Warm
Curious	Guilty	Pleased	Wild
Disappointed	In-control	Productive	Worried

Appendix B

Mean liking scores on a 9-point Hedonic scale for each consumer cluster and coffee sample [7].

Cluster	Breakfast	Italian	Kona	Nantucket	Newman	Sumatra
C1 (<i>n</i> = 20)	7.7	6.9	7.3	7.7	7.5	7.2
C2 (<i>n</i> = 17)	4.4	6.9	6.7	6.1	7.2	6.5
C3 (<i>n</i> = 24)	7.0	6.0	5.8	7.5	5.3	3.7
C4 (<i>n</i> = 13)	4.6	3.5	5.7	6.0	5.5	5.4
C5 (<i>n</i> = 10)	7.1	3.3	3.5	4.1	2.2	2.1
C6 (<i>n</i> = 10)	5.9	6.4	7.0	3.6	5.1	6.1

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