The Influence of Labeling On Kombucha Consumers

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RESEARCH

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ABSTRACT

This research aims to understand consumer preference for kombucha, a fermented tea, by facial expressions (measured by automated facial analysis software) and by self-reported overall liking (using hedonic scores). This study focuses on whether or not package label colors influence emotions. One national brand of commercially packaged kombucha was chosen for the study based on the uniformity of its labels. Three labels in different colors (orange, yellow, and green) were used to test consumer liking of two different flavors of that brand of kombucha. The data showed that the mean overall liking of kombucha in a bottle with a green label (7.19) was significantly higher ($p<0.1$) than the overall liking of the same kombucha with a yellow label (6.58). Facial expressions evoked by kombucha were generally low in intensity. Although there were no significant differences in facial expressions elicited by the two labels ($p>0.05$), the yellow label was observed to have a higher probability to stimulate negative emotion (evidence value (EV) disgust=1.139) than the green label (EV disgust=1.137).

Keywords: Consumer preference; hedonic scores; facial expressions; automated facial analysis software; package label color; kombucha.

INTRODUCTION

It is no secret that color plays an important role in influencing consumer behavior; numerous studies over decades of research have proven that time and time again. A well-designed package can definitely influence consumers' decisions to buy one product over another [1]. A colored design that stand out can catch consumers' attention and inspire their purchase [1,2], with 62% to 90% of impulse purchases being made based solely on the color of the package or product [2–4].

It is easy to review some basic color psychology information and come away with blanket statements such as "green is calm" or "brown means rugged." These statements are not wrong in and of themselves; the problem is that there is no context. Green can be a calming color and is often used to represent eco-friendly products and processes or to highlight environmental issues. But green is also used as the primary color in financial branding. Likewise, brown can reference the ruggedness of outdoor sports but it can also evoke the warmth of a season

(autumn, Thanksgiving), or whet an appetite for a tasty chocolate treat [2]. Color also affects people's perception of flavor. An experiment using virtual reality technology to change the brownness of coffee came to the conclusion that light brown coffee makes people perceived more creamier than dark brown coffee [5].

Beginning a package design process with a broad statement such as “everyone loves blue” [6] is not a bad thing, but it’s important to understand that from there, scientific evidence of consumers’ color preference should be collected on an emotional level. How colors affect consumers depends entirely on each consumer’s personal culture, experiences, religion, country, and so on [2,4]. It is not possible to design a package that will appeal to all consumers; however, knowing that color affects consumers in different ways is a good starting point for exploring ways to develop deep and lasting brand-customer relationships [6].

Ciotti [2] states that there are no hard-and-fast rules for choosing the right colors for your package, but the good news is that color psychology can help you make the right choice. Without question, color impacts consumer behavior [6], but with everyone reacting subjectively to colors, it can be difficult to select the right colors for a package design. The key is to select the colors that are appropriate to the package or the product; the question to ask is “does this color fit the product being sold?” [2,3]. “Purchasing intent is greatly affected by colors due to their effect on how a brand is perceived; colors influence how customers view the ‘personality’ of the brand in question. It’s far more important for colors to support the personality you want to portray instead of trying to align with stereotypical color associations” [2]. Color is important, but it’s how consumers perceive the color that impacts their purchase decisions [1] and if brands work to understand their consumers on a deeper level, they will be better able to connect with their consumers by affecting their mood and appealing to their emotions [6].

Response to colors is both psychological and personal [6]. Understanding the relationship between emotions and consumer responses to colors is one of the most important things in creating a successful package design [3,7]. Citing a 1994 study, de Wijk et al [8] noted that emotions are unconscious responses to external stimuli; they can be caused by a variety of factors such as “an unexpected situation, memorizing, talking about a past emotional experience, or seeing the emotional reactions of another” [7].

As far back as the discoveries of Darwin, facial expressions have been known as the most apparent non-verbal evidence of emotions [8]. Unlike colors, which can have differing interpretations based on age or culture [2,4], facial expressions tend to be fairly universal [7,8], leading to a natural conclusion that analyzing facial expressions as a gateway to consumer emotions is an option worth considering for developing package designs [7]. Work has been done in this area and it has been confirmed that measuring emotions does provide valuable insight and information beyond the traditional questionnaires and surveys that study participants complete as part of the research process [9]. In fact, it has been shown that combining facial expression analysis with more traditional data collection methods provides a much broader understanding of consumer responses and behaviors [10].

One of the forerunners in modern facial expression research is Ekman [8] who defined and studied six basic expressions: surprise, disgust, sadness, anger, fear, and happiness [11]. Facial expression recognition software is built to automatically recognize and quantitatively analyze these six expressions in minute detail, with an accuracy rate of 90% [7]. These automated facial expression analysis [AFEA] software tools identify and measure differences in intensity of specific points on the face [10]. Use of AFEA programs is increasing due to their sophistication and superiority over other methods, such as speech, as a way to evaluate consumer emotions [7,10].

One of the goals of this study is emotional analysis, which is imperative to decide which method is the best one to use [12]. With the hope of providing a more rounded understanding of participant responses, a mixed-method approach was used for this research project. Participants self-reported their liking but they were also recorded and

their facial expressions were evaluated and analyzed by AFEA software.

For this study, participants sampled several beverages then self-reported on a ballot how well they liked each one. While they were sampling the beverages, their faces were being recorded, with the videos being analyzed later using AFEA software. The facial analysis data was compared to the self-reporting results to see if the participants' subconscious reactions matched the preferences indicated on their ballots.

MATERIALS AND METHODS

Participants

The study was approved by the Institutional Review Board at Clemson University prior to recruiting participants. All participants signed an informed consent form and received an incentive for their participation.

Eligible participants registered to participate at a specific time and they were the only participant allowed in the facility during that block of time. Thirty-one people took part in the study: 23 females, and 8 males. Their mean age was 33 years old, with a standard deviation of 11 years. Demographic information was gathered regarding race (one African American, 30 Caucasians) and country of origin (one from Sweden, one from the United Kingdom, 29 from the United States).

Participants were recruited via an emailed survey sent to untrained consumers who had consented to be on a research email list. Exclusion criteria included the following: physical limitations, allergies associated with the ingredients in kombucha, had never had kombucha, and/or had a beard or mustache. Only prospective subjects who met all the criteria of the study were redirected to a scheduling page to select a date and time to participate in the kombucha tasting study.

Sample Preparation

Kevita Master Brew Kombucha is a commercially prepared, bottled, and labeled brand of kombucha. It was chosen for this study due to the uniformity of the design elements in the labels; the labels are the same design format for all flavors with a different color representing each different flavor (Figure 1). The arrangement of the label elements made it easy to cover only the part of the label that provided flavor information while maintaining a uniform look for each bottle (Figure 2).

Figure 1. Commercially packaged and labeled KEVITA® Master Brew Kombucha

The bottles were chosen for the colors of their labels — green, yellow, and orange — though only two of the flavors, pineapple peach and citrus, were used in the study; the third flavor was discarded. The bottles were emptied, washed, then filled with one of the two flavors being used: pineapple peach was added to the bottle with the orange label and the citrus flavor was added to the bottles with the yellow and green labels. Each bottle was then labeled with a code number that covered the flavor information on the bottles' labels so that the only detectable difference across the three bottles was the color of the label (Figure 2). The bottle with the orange label (pineapple peach) was labeled #781; the yellow label (citrus) was labeled #524; and the green bottle (citrus) was labeled #237.

All subjects in the study were assigned participant numbers ranging from 1 to 40. The participant number was added to the ballot and the demographic survey. Subjects with odd participant numbers received the sample serving order shown in Table 1 while participants with even numbers received the sample serving order shown in Table 2. Sample cups with corresponding ID numbers were placed in front of the commercially labeled bottles to make the association between them, as seen in Table 1 and Table 2.

Figure 2. Bottles coded with 3-digit numbers with original flavor information hidden

Table 1. Sample serving order for odd participant numbers

Serving order left to right				
Flavor	Citrus	Pineapple Peach	Citrus	
Label Color	Green	Orange	Yellow	
Code Number	237	781	524	

Table 2. Sample serving order for even participant numbers

Serving order left to right				
Flavor	Citrus	Pineapple Peach	Citrus	
Label Color	Yellow	Orange	Green	
Code Number	524	781	237	

Test Procedure

Each participant arrived at the test facility, Package InSight LLC, in Greenville, South Carolina USA, during the specific time block for which they had registered. The researcher explained the test while adjusting the camera to an appropriate height for each participant. When the camera was ready and recording, the participants looked at the camera for ten seconds with a neutral facial expression. Then they tasted the samples in order, from left to right according to their participant ID number (see Tables 1 and 2), cleansing their palate between each sample using water and a spit cup. The camera recorded their expressions for each sampling but participants also rated their overall liking of each flavor on a paper ballot, using a 9-point scale, also known as a hedonic scale. The participants were also required to complete a survey that gathered information about demographics, history of kombucha consumption, and purchasing decisions after the sensory evaluation. They received an honorarium Amazon gift card for their volunteer service.

Data analysis

Overall liking

Mean hedonic scores were calculated by averaging all participants' ratings per kombucha sample. Within each kombucha sample, a one-way ANOVA was conducted to evaluate overall hedonic means (Student's t-test) using JMP® Pro (version 14.3, SAS Institute Inc., NC, USA).

Facial expression analysis

The evidence value (EV) represents the confidence and possibility of the occurrence of the facial expressions, ranging from 0 (no expression) to 100 (fully expressed) [13]. Due to the large possible differentiation of the data, ln EV [EV logarithmically (base e)] was used in data analysis, ranging from -∞ to 4.6. When ln EV of a certain facial expression is 0, it means the EV equals 1, which means the probability of the facial expression appearing is 1% compared to 0 (neutral face). If a facial expression is determined as fully expressed by software, then EV is 100, with ln EV near the value 4.6. When the value of ln EV is more negative, the EV is closer to 0, indicating that the

expression is less likely to occur, and the closer it is to a neutral state (Figure 3).

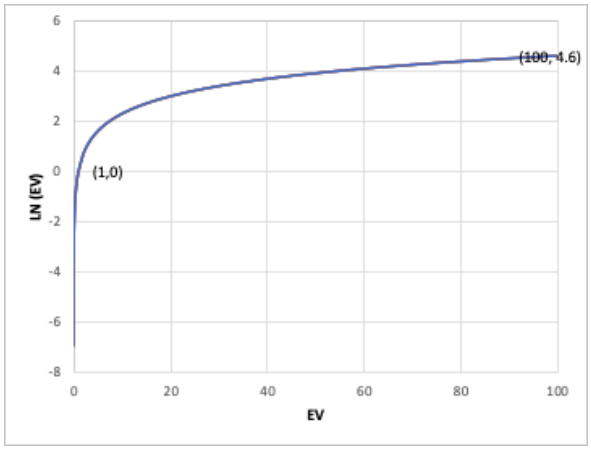


Figure 3. EV vs □ln ln EV

To identify whether there were significant differences across kombucha samples (237, 524, 781) per emotion, repeated one-way ANOVAs and means test (Student's t-test) were run using maximum ln EV as responses and tastes as factors in JMP® Pro (version 14.3, SAS Institute Inc., NC, USA). Whether there were significant differences within a sample across seven emotions was also studied using Student's t-test. Correlation between overall liking and facial expression was determined by linear regression analysis.

Correlation between overall liking and facial expression

Relationship between overall liking and facial expression was determined by linear regression analysis using JMP® Pro (version 14.3, SAS Institute Inc., NC, USA).

Results

Ballots: Comparison of mean overall liking across three kombucha samples

All kombucha samples were seen as liked samples by participants, with mean hedonic scores all over 6 (6=like slightly, hedonic scores ranging from 1 to 9). The only difference between Sample 524 and 237 was the label color, both beverages were citrus flavored. Figure 4 shows that the mean hedonic score for 524 (6.58±1.57) was lower than 237 (7.19±1.05). However, differences were not statistically significant as ANOVA resulted in p=0.061, slightly above the threshold of significance (p<0.05); which indicates that label color did not affect the overall liking between citrus samples (524 and 237). The mean overall liking of the sample 781, pineapple peach, was 7.90±1.14. This was significantly higher (p<0.05) than both citrus flavored kombuchas (samples 524 and 237), indicating that there was a flavor preference among the sampled population.

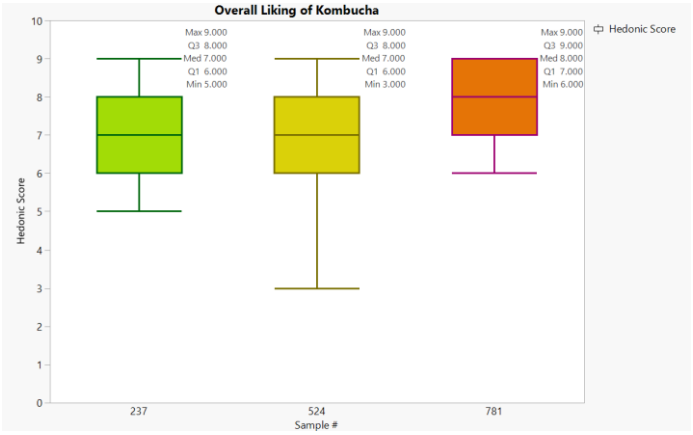


Figure 4. Box Plot: Overall liking of kombucha as determined by participants' self-reported 9-point hedonic score ballots. Bar color indicates packaging label color. Treatment: 237 (citrus flavor, green label); 524 (citrus flavor, yellow label); 781 (pineapple peach flavor, orange label).

AFEA: Comparison of facial expression analysis across three kombucha samples

Results from repeated one-way ANOVA showed that no significant differences (p>0.05) were observed for maximum EV for all seven facial expressions across all three treatments [see the raw maximum lnEV in Table 3]. Facial expressions with lnEV less than 1 indicates a low probability of expression. Disgust and surprise were two facial expressions which had the highest confidence scores (EV) indicating emotion occurrence for all samples.

Samples could not be differentiated through one-way ANOVA based on ln EV values from iMotions data. In Table 4-4, the least liked samples, 524 (citrus) and 237 (citrus), were associated with the highest disgust lnEV values of 0.130±1.359 and 0.128±1.206 respectively. Surprise was also high for 524 and 237, with lnEV values of 0.189±1.578 and 0.195±1.627 respectively.

Table 3. Comparison of Maximum lnEV (ranging from -∞ to 4.6) ±Standard deviation of facial expressions basic taste solutions. Pineapple peach (781) had higher overall liking and lower EV for disgust and surprise. Citrus (237 and 524) had lower overall liking and higher EV for disgust and surprise. EV values for disgust and surprise were not significant across kombucha samples (p>0.05).

	Sample 237	Sample 524	Sample 781
Color	Green	Yellow	Orange
Flavor	Citrus	Citrus	Pineapple Peach
Overall Liking ± SD	7.19^{b}±1.05	6.58^{b}±1.57	7.90^{a}±1.14
LnEV(Anger)	- 3.370^{cA}±1.755	- 3.004^{cA}±2.540	- 3.054^{cA}±2.359
LnEV(Contempt)	- 1.382^{bA}±0.979	- 1.546^{bA}±0.178	- 1.443^{bA}±0.584
LnEV(Disgust)	0.128^{aA}±1.206	0.130^{aA}±1.359	0.030^{aA}±0.907
LnEV(Fear)	- 1.644^{bA}±4.140	- 1.796^{bA}±3.902	- 1.629^{bA}±4.166
LnEV(Joy)	- 5.231^{dA}±1.468	- 5.255^{dA}±1.523	- 5.186^{dA}±1.794
LnEV(Sadness)	- 3.551^{cA}±0.763	- 3.369^{cA}±0.810	- 3.295^{cA}±1.000
LnEV(Surprise)	0.195^{aA}±1.627	0.189^{aA}±1.578	0.017^{aA}±1.436

^{a,b,c} indicates a significant level within a column (p<0.05).

$^{A, B}$ indicates a significant level within a row (p<0.05).

The most liked sample was 781 (pineapple peach) which evoked the least disgust (lnEV=0.030±0.907) and surprise (lnEV=0.017±1.436) facial expressions. When comparing emotions across samples, no significant differences in lnEV were observed (p>0.05). However, it was observed that when overall liking decreased, the chance of appearance of negative emotion (disgust) would increase.

AFEA: Comparison of facial expression analysis within the kombucha samples

Kombucha-evoked facial expressions were all in low intensities, especially for the joy emotion (average lnEV= -5.224). Significant differences (p<0.05) were observed when comparing maximum lnEV of the various emotions within a sample; no significant differences were observed when comparing each emotion's maximum lnEV across samples (p>0.05). This indicated that kombucha samples were able to elicit discriminable emotional responses rather than resulting in flat emotional responses (almost all expressions have the same intensity). For all comparisons within treatments, EV of disgust and surprise emotion were significantly higher (p<0.05) than other expressions, followed by EV of contempt and fear. Sadness and anger were the second and third lowest emotions elicited by all kombucha samples (Table 4-4).

Correlation between overall liking (ballots) and emotional response (AFEA)

Correlations coefficients (r) between overall liking and facial expressions can be seen in Table 4. Correlations with r2 less than 0.03 ruled out potential correlations and were excluded from the table. Positive facial expressions (joy), and some negative facial expressions (sadness and fear) showed no correlation with overall liking. Surprise and negative expressions including anger, disgust, contempt were all found negatively correlated with overall likings. It was expected that less liked kombucha samples were associated with a higher possibility of negative emotions.

Large negative correlations were found within sample 781 for the disgust and surprise expressions. For the less liked

samples the negative correlation generally decreased, effect size decreased, and the p values were above the threshold of significance. It was observed that as the hedonic liking decreases, the possibility of the appearance of negative emotions increases.

Table 4. Correlation between overall liking and facial expressions (exclude r2 less than 0.03).

Sample	Overall Liking (Mean±SD[4])	Facial expression	(r^1)	(r^2)	Effect size[2]	p-value[3]
237	7.19[b]±1.05	Anger	-0.321	0.103	Medium	0.078
524	6.58[b]±1.57	Anger	-0.173	0.03	Small	0.322
		Disgust	-0.235	0.055	Small	0.201
		Surprise	-0.205	0.042	Small	0.269
781	7.90[a]±1.14	Anger	-0.310	0.096	Medium	0.090
		Disgust	-0.857	0.735	Large	<0.0001
		Surprise	-0.713	0.508	Large	<0.0001
		Contempt	-0.447	0.200	Medium	0.012

[1]Correlation coefficient

[2]Correlation coefficients with absolute value of 0.1, 0.3, 0.5 represent small, medium, large strength of relationship (effect size) respectively (14,15)

[3]Threshold of significance (p<0.05)

[4]Mean scores (± standard deviation).

a,b superscripts on overall liking (mean hedonic scores) in a column indicates significantly different among treatments (p<0.05).

Discussion

Overall Liking of Kombucha Samples

The mean hedonic scores of three kombucha samples were all over 6, on the 9-point hedonic scale, indicating all of the samples were liked by participants (Table 3). This was expected because only 29% of participants did not select citrus as their favorite flavor (Appendix A, Figure L-2). The current data did show that flavor preferences were present within the studied population and that participants preferred the pineapple peach over the citrus flavor.

No significant differences were observed between the two citrus samples. The only difference between citrus samples (237 and 524) was package profile (label color), however, the overall liking (hedonic scores) of sample 237 was higher than 524.

Emotional Expression Resulting from Kombucha Tasting

No significant differences were found in AFEA data when comparing maximum lnEV across kombucha samples within the seven emotions (p>0.05). Whether facial expressions detected by iMotions can distinguish emotions elicited by different kombucha products in this study remains to be verified. However, in terms of hedonic liking, those samples were all seen as liked samples (hedonic scores>6). This indicated that no significant differences were found in facial expressions triggered by liked samples. Previous studies also demonstrated that implicit methodologies for AFEA studies failed to discriminate between liked (rating 7-9) and neutral (rating 4-6) samples; only disliked samples could be distinguished by significantly higher intensities of negative expressions expressed (rating 1-3) [16]. Implicit methodologies appear to be better applied to situations where researchers are investigating samples that are not liked. Since all samples in this study

were liked, explicit methodologies, or instructing the participants to “make a face representing their impression of the sample” may have better results when differentiating between label effects and taste effects for liked samples [17].

A key feature of the AFEA study was the low intensity of expressed emotions expressed throughout the study. The highest maximum EV was observed for the surprise emotion in sample 237 (EV=1.215). Throughout the study these low intensity facial expressions were present, especially for the presence of joy in 524 (EV=0.005). Very limited publications can be found using iMotions software to measure facial expressions in the food tasting area [17], though one study showed that the highest EV (disgust) and the lowest EV (fear) during the post-consumption stage of mixed vegetable juice was 3.388 and 1.017 respectively, without listing the insignificant EV of joy and surprise [18]. Kostyra et al. [19] investigated facial expressions evoked using hams as the stimulus, measured by FaceReader 4, finding similar low intensity expressions. Those results showed that, with the exception of high intensity neutral emotions, other facial expressions were low in intensity, with the lowest and highest intensities being 0.007 and 0.187 respectively (intensity scale 0-1).Through leveraging cutting edge techniques in data science, personalized machine learning algorithms could be used to identify these low intensity meaningful signals in the highly variable and noisy AFEA data [20].

There were other reasons possibly leading to low overall EV of facial expressions. It may because the vast majority of participants happen to have a "poker face", which means that facing all samples, whether they like it or not, they are more likely to show “neural face” (EV=0) instead of showing any positive or negative emotions [19]. A few studies have paid attention to the phenomenon of poker face, a result of the lack of facial expressions expressed by participants. Due to the unfamiliar experimental environment or the high concentration of experimental procedures, some people exhibited a “poker face” [21].

Another study also indicated that joy was very low in intensity elicited by liked samples when using implicit methods [16]. Spontaneous facial expressions (implicit) were analyzed right after participants swallowed samples and before moving to questionnaires. Intentional facial expressions (explicit) were required to best express participants’ likings towards samples. The results showed that the intensity of joy intentionally shown by participants was significantly higher for the explicit method when compared to the implicit method for liked samples. Selection criteria for implicit versus explicit methodology should be a component of the design of experiment, as this seems to influence how participants express emotions under laboratory conditions. This could include approaches where both explicit/implicit responses are studied, especially in cases where the liking of the samples is unknown.

Limitations

When using the AFEA software to recognize facial expressions during the post-consumption period of food and beverages, the period consists of chewing and swallowing of food, it will interfere with the recognition of facial muscle movements elicited by food itself. Since the test sample used was a beverage instead of solid food, chewing was avoidable during the tasting period. By including details in the general information indicating that participants should avoid chewing and exaggerated mouth opening and closing, the interference to facial recognition software could be diminished. Instead of measuring facial expressions right after consumption when the cup was below the chin of participants, analyzing facial expressions after swallowing foods or beverages could be considered to minimize disturbance to the software [19].

One of the limitations of this experimental design was that the taste differences between the samples were relatively small; only the fruity flavor that was liked by most participants in the questionnaire survey was studied. It is worth investigating kombucha flavors that would be potentially disliked by most people because negative hedonics are shown to elicit stronger emotional responses

[16]. Additional survey questions could explore tastes among kombucha consumers. For example, in the questionnaire survey (Appendix A, Figure L-2), only 3.2% mentioned that they like to drink “veggie flavor” kombucha. It was concluded that AFEA could be used to differentiate disliked samples with more negative emotions expressed. Whether facial expressions can be used to differentiate disliked and liked samples could be studied by adding potential disliked flavors of kombucha.

The small sample size (n=31) is another limitation of this study causing a lack of difference in facial expressions across samples. The sample size number was in the range of 10-50 recommended by [22], but it was less than the mean participants’ number (n=68.7) and median number (n=50) reflected in an article reviewed food and beverages related AFEA studies published between 2009 and 2019 [17]. This could make it difficult to detect the significant differences exhibited in facial expressions because of large individual taste variability (high standard deviation) [23]. Due to the large amount of variation between participants, the sample size may not be large enough to get representative results.

Software sensitivity

There are limited publications regarding detecting facial expressions in the area of food and beverage using iMotions software. Samant et al. [18,24,25] indicated that facial expressions measured by iMotions along with sensory aspects could be good indicators for predicting consumer preference of basic taste solutions and commercial vegetable juices.

The AFFDEX engine was selected to analyze facial expressions using iMotions. The support vector machine (SVM) classifiers are trained to do a “rolling baseline” on a video segment imported by users [26]. This means the AFFDEX engine will automatically do a baseline calibration by justifying the difference between the tester's expression and the natural state of expression. The neutral face was contained in the five-second post-consumption period because it was difficult to keep one emotional state for a long period in the dynamic videos. In a previous study that detected facial expressions using FaceReader 6, a manual calibration setting was needed to subtract facial expressions under treatment from emotional value under control (neutral face) [22,23].

The way the classifier (SVM) works indicates that longer videos have the potential to get more rational and accurate data since they will get more chances to reveal peoples’ neutral states. No publications were available in terms of baseline correction. In the AFFDEX algorithms, whether a neutral face of respondents is needed to combine with the stimulus video to provide more information remains to be determined.

Purchase intent

Individuals' familiarity with the brand may also affect peoples’ instant facial expressions. In this study, for those participants who were familiar with the brand (KEVITA®), the performance of emotions such as "fear" and "surprise" might be reduced. In addition, individuals who buy kombucha according to their habits (see Appendix A, Figure L-3, in this study, 3.2%) might be averse to new products. In this case, they were more likely to prefer familiar products. Since the brand information was exposed to participants, for those individuals whose purchase decisions indicated that they were affected by the brand (see Appendix A, Figure L-3, in this study, 6.4%), the overall liking might also be influenced.

Purchase intent prediction models might be meaningful to build in future studies. Except for frequency of consumption (see Appendix A, Figure L-1, in this study, 77.4% of participants drink kombucha at least once a month), more useful information like product familiarity, brand liking information, and purchase intent were not collected in this study. Researchers have been developing a prediction model by building multivariate regressions between buying decision and sensory hedonic scores, emotions (measured by AFEA or self-reported emotion), questionnaires (related to purchasing intent behavior) [18,27]. A buying prediction model for vegetable juice suggested that product purchase intent negatively correlated with negative emotions (measured by facial expression analysis and self-reported emotion

questionnaire) and positively related to positive emotions (18).

Conclusion

Overall liking and facial expressions elicited by packaging label color - yellow and green (extrinsic factors) of citrus flavored kombucha beverage were studied, the findings of this study determined:

Overall liking towards samples indicated that all samples were liked (hedonic scores over 6) by participants. The pineapple peach was preferred to the citrus. Label color did not influence the preference of citrus flavored samples.

The overall evidence value (EV) indicating the possibility of the appearance of the facial expressions, were low for all emotions across all kombucha samples

Facial expressions measured by iMotions could not be used to differentiate "liked" kombucha samples through implicit methods. No significant differences were found in any facial expressions elicited by kombucha samples. This may be due to lack of intensity or variability of stimuli or software sensitivity. Explicit methods weren't explored in this study.

When AFEA is coupled with sensory ballots (9-point hedonic scores) negative correlations were found between negative emotions and overall liking. Larger negative correlations for negative emotions were observed for sample with higher hedonic scores. This evidence points towards the presence of a relationship between facial expression and kombucha preference, however further research is required.

Optimizing the design of experiment and leveraging of cutting-edge data science techniques have the potential to achieve differentiation of beverage samples with AFEA; providing new tools for studying the relationship between beverage preference and emotional response.

Appendix A: Results of the demographic survey

Figure L-1. Frequency of consumption

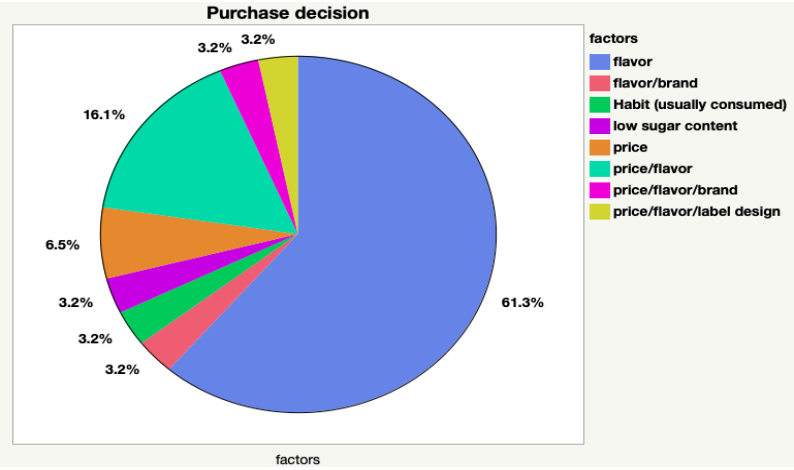


Figure L-2. Liked flavor

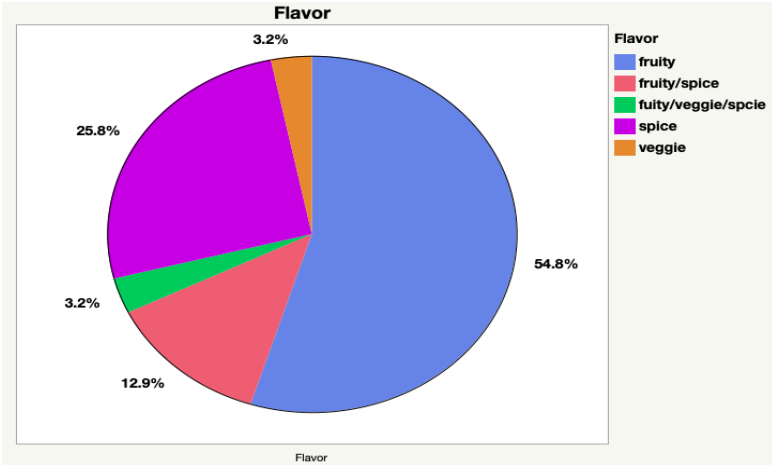
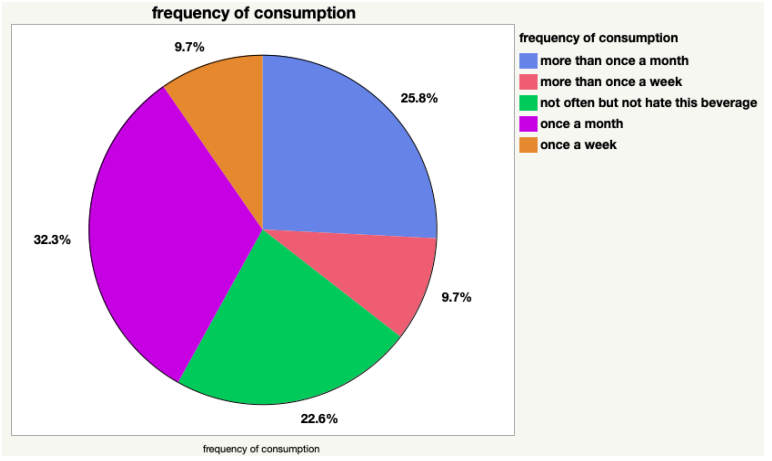


Figure L-3. Purchase decision



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