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Consumer responses to smoke-impacted pinot noir wine and the influence of label concepts on perception

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ABSTRACT

While wildfire's impacts on wine have been considered a defect due to the introduction of smoke-related off-flavours, limited studies have investigated consumers responses to smoke-impacted wines. The aims of this work were (i) to explore how New Zealand consumers respond to smoke-impacted wine; (ii) confirm whether clusters of consumers existed and characterise them by their liking of smoky flavours in foods/beverages and subjective wine knowledge; and (iii) explore how different label concepts influence consumer responses. Participants responded to liking, emotions, and perceived sensory attributes of five blends of smoke-impacted wine with non-impacted wine, along with a smoke-impacted wine presented with four different label concepts. Two clusters of consumers were identified, with one disliking the smoke-impacted wine (smoke-dislikers) and the other cluster liking (smoke-liker). The smoke-liker cluster indicated a greater liking of smoke flavours in foods and beverages, along with a higher level of subjective wine knowledge. For the labels, the introduction of the label concept significantly increased liking of the wine for the smoke-dislikers, as well as had the power to elicit different emotions and sensory experiences. This research provides vital information to the wine industry as they adapt to future wildfire years, along with how the distinct sensory profile may not be detrimental to consumer acceptance and can be modulated by the type of information on label. Further research is needed to explore how different populations and wine styles correlate with these findings, and the effects of varying levels of smoke exposure in Pinot noir and other grape varietals.

1. Introduction

Globally, over 400 million acres of land are burned by wildfires annually (System, 2024). The smoke from these fires contains volatile compounds that can impart aromas and flavours to foods. Wine-producing regions around the world have seen a notable increase in wildfire occurrences, which has impacted the quality of wine grapes (Krstic et al., 2015). Currently, it is estimated that wildfires cause $150 million in damage in New Zealand each year and is anticipated to increase to over $550 million by 2050 (Universities, 2024). There are currently over 42,000 ha of vineyards across several regions in New Zealand, with a majority lying in the Marlborough region, which is predicted to have severe wildfire danger in coming years (Inc, 2024). The most produced grape varietals in New Zealand are Sauvignon blanc and Pinot noir, both of which have exhibited smoke-related sensory attributes when exposed to smoke in the vineyard, indicating the importance of understanding this issue for future vitality of the New Zealand wine industry (Ristic et al., 2015). As of 2024, the New Zealand wine industry has not experienced the impact of wildfires on wine that has been seen in places like Australia and the United States, making this population of interest to see how those in an unimpacted region respond to these wines. While this may not be a current issue, the increasing occurrence of wildfires raises concerns about potential issues in the coming years.

Wines produced from smoke-affected grapes are described as having smoky, burnt, and ash tray aromas and flavours along with a lingering ashy aftertaste and excessive in-mouth drying (Høj et al., 2003). Smoky attributes are not inherently a deprecator to wine quality, as it can be desirable in wines aged for extended periods in oak and are typical descriptors in certain wines, like Burgundy Chablis and Australian

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Chardonnay (Gambetta et al., 2017; Parker et al., 2024). The issue arises with the excessive smokiness found in wildfire affected wines, with consumer research showing that high intensities of smoke flavour are negative drivers of liking across different wine styles (Bilogrevic et al., 2023). However, the authors also revealed that consumer responses to smoke flavour varied, with clusters showing different levels of responsiveness and acceptance. With this variability in sensitivity and liking in consumers, the question arises: is smoke taint inherently a defect in wine, or can it be considered a unique characteristic?

In sensory research, hedonic testing is a well-established method to understand consumer responses to products, however, it has been found to not accurately predict food choice behaviour (Dalenberg et al., 2014). While liking can give an indication of the immediate impression of a product, it does not capture the consumer experience and choice processes (Thomson, Crocker, & Marketo, 2010). Products may have similar overall liking, but key insights can be found from emotions elicited by products (Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014). Measuring emotions in wine research has shown growing interest, as wine is an inherently well-liked product. Specifically for red wine, lexicons have been developed to determine the most relevant emotions for consumers (Mora, Dupas de Matos, Fernández-Ruiz, Briz, & Chaya, 2020). Through this research, links have been established between sensory, emotions, and physiochemical characteristics of wine, providing the wine industry with a better understanding of how consumers interact with their products (Mora et al., 2021).

When faced with a smoke event, wine producers have many tools and decisions they can take to make a "viable wine" for the market. One is the utilisation of blending, by mixing a smoke impacted wine with a non-impacted wine. Wine blending is a common practice to achieve desired sensory attributes in the final product (Hopfer et al., 2012). This practice has shown some level of efficacy in reducing off-notes, but it is highly dependent on the degree of smoke impact on the starting wine (Mirabelli-Montan et al., 2021). Additionally, some winemakers may choose to cut their losses by not producing nor selling the wine, thereby avoiding potential negative consumer feedback and impact on their branding. Those who choose to sell the wines can apply different approaches to labelling and marketing. Wine labels convey important information that can influence consumer responses (Coppin et al., 2021). Of the dimensions of wine quality, five of the seven are extrinsic properties, which include the origin, vintage, aging ability, image and presentation. Elements such as label readability and wine descriptions can significantly affect consumer feelings towards a wine (Danner, Johnson, Ristic, Meiselman, & Bastian, 2017; Gmuer, Siegrist, & Dohle, 2015). While these extrinsic cues influence consumers responses to wine, they are not universal and are dependent on individual differences, which includes their level of wine expertise (Honoré-Chedozeau et al., 2020). Wineries have used different labelling strategies, however, there is still a scientific gap in understanding how this impacts consumer responses to smoke-impacted wine.

The aim of this study was to explore how New Zealand consumers respond to smoke-impacted wine, both presented blindly in blends (smoke impacted wine with a non-impacted wine) and presented with different label concepts. With prior research identifying consumer clusters based on their liking of smoke-impacted wines, the study also sought to confirm whether such clusters existed among New Zealand consumers and characterise them by their general liking of smoky flavours in foods and beverages as well as their subjective wine knowledge. This research also explored how different label concepts influence consumer response, which included altering the vintage year, wine name and description. Additionally, evaluation of the smoke-impacted wine in a blind condition was compared to the consumers response in the informed conditions.

2. Material and methods

2.1. Samples

Wine samples were commercially produced from Pinot noir (*Vitis vinifera*) grapes cultivated in Oregon (OR), USA. The smoke-impacted wine was a commercially available 2020 vintage from Oregon. The non-smoke wine was produced at the Oregon State University Research Winery (Corvallis, OR) using non-affected grapes harvested in 2021 from the Woodhall III Vineyard (Monroe, OR). The basic chemical parameters of the wine are reported in Table S1. The two wines were tasted by a panel of wine experts (n = 35) in Oregon, USA to ensure that they were representative of the sensory attributes found in smoke-impacted and non-impacted Pinot noir wines. Wine experts described the 2020 smoke-impacted Pinot noir with significantly higher intensity of ashy, burnt, and smoky flavour attributes than the 2021 Pinot noir (data not shown).

The study comprised wines presented in two conditions: blind (wine blends) and informed (label concepts). In the first part, five wine blends (0 %, 25 %, 50 %, 75 % and 100 %) were served blindly to participants. The percentage in the blend indicates the amount of the smoke-impacted wine (2020 Pinot noir) added in each blend. In the second part (informed condition), the smoke-impacted wine (2020 Pinot noir) was accompanied by different wine label concepts (2018, 2020, Smoke Stack, and Unity). Labels were presented on the screen as shown in Fig. 1, one at a time.

The wine was stored under refrigerated conditions (4 °C) until shipment from the United States to New Zealand and then were stored at room temperature until use (~21 °C). Each day of consumer testing, new wine bottles were opened for use.

2.2. Consumer study

2.2.1. Participants

Participants were recruited from the Food Experience and Sensory Testing (Feast) Laboratory consumer database and via flyers in the community (e.g. cafes, liquor stores, wine shops) (Palmerston North, New Zealand), met the following criteria: red wine consumer (more than once every 2–3 months), willing to attend one-hour session, aged 21–70 years old, not pregnant or lactating, not allergic or intolerant to any of the ingredients listed in the participant information sheet, not taking any medications with alcohol interactions, no history or current issues with alcohol abuse/alcoholism, not regularly using tobacco products (more than once a month), no oral lesions, no taste deficits, and able to communicate competently in English.

A total of 197 participants (128 female, 69 male) was recruited from these criteria, with a mean age of 43.4 years ± 13.6. Most participants (88 %) declared consuming red wine once a month, on average, with the remaining participants consuming it every two to three months.

2.2.2. E th ics approval

The study was reviewed and approved by the Massey University Human Ethics Ohu Matatika 1 committee (Approval OM1 23/61). Prior to study attendance, participants were asked to read an information sheet providing all study details and provide informed written consent. Participants were assigned a unique code to ensure anonymity. Upon study completion, participants were offered a snack treat and a supermarket voucher as compensation for their time.

2.2.3. Study procedure

The study was conducted in sensory booths (20 ± 1 °C) at the Feast Laboratory in groups of up to 11 people. Prior to beginning sample evaluation, participants were briefed with the study procedure. At this time, they were provided with a list of emotion terms and sensory attributes with synonyms/definitions/examples to become familiar with them prior to sample evaluation (Tables S2 and S3). The session was

Fig. 1. Label concepts presented in the second part (informed condition) of the consumer study with the 100% smoke-impacted wine. A/B were presented first, followed by C/D labels.

structured into two parts: part one with the wine blends and part two with the label concepts (with a forced five-minute rest in between). Each of these conditions was composed of a consecutive series of identical tasks, where three types of responses were collected. The first was overall liking on a fully labelled 9-box hedonic scale from "dislike extremely" (1) to "like extremely" (9) (Peryam & Pilgrim, 1957). Second, using a rate-all-that-apply (RATA) method, participants were asked to select whether they felt a particular emotion (Ares, Bruzzone, et al., 2014). If yes, they rated the intensity of the emotion on a 9-box scale from "very weak" (1) to "very strong" (9), otherwise "not at all" (0) was selected. The emotion words (Table S2) were selected from the EsSense25 profile (Nestrud et al., 2016) and lexicons developed specifically for wine (Mora et al., 2020) to cover the valence and arousal regions of the circumplex model of emotion (Jaeger, Worch, Phelps, Jin, & Cardello, 2020).

Finally, sensory product characterisation was performed via check-all-that-apply (CATA) including 18 sensory attributes: 2 tastes, 13 flavours and 3 textures/mouthfeels (Table S3). Using existing literature in Pinot noir wine and smoke-impacted wine research as inspiration (Fryer, Collins, & Tomasino, 2021; Parker et al., 2012; Tomasino et al., 2023), consumer-friendly terms were selected following pilot work for their ability to describe and discriminate samples. Participants were instructed to use the 'other' option with a comment box to add any attributes not listed in the CATA question. To minimise order bias, both emotion and sensory term order were balanced across consumers, but each consumer retained the same order throughout the evaluation session.

At the end of sample evaluation, information on participants consumption habits, which included questions on smoke flavour liking (9-point hedonic scale) along with consumption of foods and beverages with smoke flavour (CATA). Questions regarding red wine consumption, including frequency, location (CATA), and style (CATA) were additionally asked. Finally, subjective wine knowledge (Table 1), adapted from Ellis and Caruana (2018), was collected. Compusense software version 24.10 (Compusense Inc., Guelph, Ontario, Canada) was used for data collection.

Table 1
Average rating for the whole consumer panel and by each cluster, and associated p-values for overall smoke flavour liking and wine knowledge questions in post-evaluation survey. p-values from *t*-test comparing average score between clusters. **Bolded** p-values indicate significance at 95% confidence interval.

Question	Whole Panel	Cluster		p-value
		Smoke Dislikers	Smoke Likers	
How much do you like smoky flavours in your food?[#]	6.60	6.29	6.85	**0.008**
How much do you like smoky flavours in your beverages? [#]	5.47	4.89	5.93	**<0.001**
I feel knowledgeable about wine[$]	4.15	3.93	4.32	**0.049**
Compared to most people, I know less about wine[$]	3.57	3.82	3.38	**0.031**
I know how to judge the quality of a bottle of wine[$]	4.13	3.86	4.35	**0.018**
I know enough about wine to feel confident when I make a purchase[$]	4.65	4.43	4.84	**0.047**
I can tell if a bottle of wine is worth the price[$]	3.96	3.89	4.03	0.536

[#] 9-point hedonic scale from 'dislike extremely' to 'like extremely'.
[$] 7-point scale from 'strongly disagree' to 'strongly agree'.

Wine samples were poured at the beginning of each session. Samples (10 mL) were served ambient (~21 °C) in transparent ISO 215 mL-wine glasses (Arcoroc, Arques, France), labelled with 3-digit random codes, and evaluated under red lighting to mask colour differences. Each participant received one glass per sample, one at a time, with a forced minimum 90-second break between each sample. The first sample was always a warm-up (non-vintage Pinot noir, Cleanskin Wines, Dargaville, New Zealand) to avoid first position effects (Dorado, Pérez-Hugalde, Picard, & Chaya, 2016). To ensure a consistent consumption protocol, participants were instructed to taste the sample, wait approximately 5 s,

then expectorate (spit it out) into a black spittoon (Fruugo.com Limited, Ulverston, United Kingdom) before responding to the questions. To further minimise carryover effects, participants were instructed to cleanse their palate in a consistent manner according to procedure described in Fryer and Tomasino (2022): participants were asked to sip a 4 g/L glucose solution (NOW Foods, Bloomingdale, United States), swish it around their mouth, and then expectorate into the spittoon. This was followed by rinsing with filtered water using the same procedure. These rinsing steps were repeated between samples throughout the session.

2.2.4. Experimental design

The wine blends were presented according to a balanced design based on a Williams Latin Square. Label concepts were presented in two groups to avoid bias being introduced by the more informative concepts, with concept randomised within the group. Labels A and B were presented in the first group and C and D were presented in the second group (Fig. 1).

2.3. Data analysis

Data were analysed in XLSTAT version 2023.2.1413 (Lumivero, New York, USA) and R software version 4.4.1 (R Core Team, 2024) in RStudio 2024.04.2. The α-risk was set at 0.05.

2.3.1. Part 1: Wine blends

Two-way Analysis of Variance (ANOVA) followed by a Tukey HSD's test was conducted for liking and emotion, with sample as a fixed factor and participant as a random factor, to compare the five wine blends. For sensory attributes, Cochran's Q test followed by the Sheskin procedure was performed for each of the CATA terms (Meyners et al., 2013).

Clustering of participants based on liking score of the 100 % smoke-impacted wine was conducted using Agglomerative Hierarchical Clustering (AHC) on the centred scores, using Euclidean distance and Wards method.

Following formation of clusters, analysis for liking, emotions, and sensory attributes was repeated using the multcomp (Hothorn et al., 2023) and emmeans (Lenth, 2024) package in RStudio. Two-way ANOVA was applied for liking and emotion, with sample and cluster as fixed factors along with their interaction. Tukey HSD's test was conducted when the interaction term was significant to determine differences within and between clusters. Differences in sensory characterisation between the clusters were determined using Generalised Linear Models (GLMs) with proportion citation as the dependent variable, and sample, cluster and their interaction as fixed effects (Meyners & Hasted, 2022). For attributes with significant interaction (sample*cluster), Tukey HSD's test was conducted. Penalty-lift analysis was performed for the CATA terms for each cluster independently to determine the mean impact of the presence of an attribute on mean liking (Ares, Dauber, Fernández, Giménez, & Varela, 2014). Calculation was based on a two-sample (attribute present and attribute absent) independent *t*-test. A threshold of 10 % citation frequency was used to test significance of the mean impact.

Furthermore, Multiple Factor Analysis (MFA) was used to integrate multiple datasets pertaining to the same set of products. To explore the relationship between liking, emotions and sensory characteristics for each cluster, the MFA included liking (1 variable), emotions (16 variables), and sensory attributes (18 variables) for each cluster independently (6 tables).

2.3.2. Part 2: Label concepts

Similar to part 1, two-way Analysis of Variance (ANOVA) followed by a Tukey HSD's test and Cochran's Q followed by the Sheskin procedure was used to compare the liking, emotions, and sensory attributes of the wine presented with the four label concepts (informed condition).

To determine differences in cluster response between the informed conditions (2018, 2020, Unity, Smoke Stack) and the blind condition (100 % smoke-impacted wine in part 1), a two-way ANOVA for liking and emotions, along with a GLM for the attributes, was conducted as described in section 2.3.1. MFA was used again to integrate the multiple data sets for the clusters independently.

2.3.3. Post-evaluation survey

Results from post-evaluation survey were analysed using a two-sample independent *t*-test between each cluster based on the average score for each question to determine differences in ratings between clusters for smoke flavour liking and subjective wine knowledge.

3. Results

3.1. Post-evaluation survey

From the survey results, participants had an average liking for smoke flavour of 6.60 and 5.47 in foods and beverages, respectively. Over 50 % of individuals indicated regularly consuming smoked meats, smoky dips/sauces, dark-roast coffee, and smoked paprika. Regarding red wine consumption, most participants declared consuming wines from New Zealand (91 %) and Australia (65 %). Around half of participants indicated consuming light-bodied red wines (48 %), medium-bodied red wines (52 %), as well as full-bodied red wines (61 %). From the subjective knowledge survey, all statements had an average score over 3 ('neither agree nor disagree') (Table 1).

3.2. Blends of smoke-impacted wine with non-impacted wine

Overall, across the consumers, there was no significant difference in liking scores between the blends of the smoke-impacted wine ($p = 0.677$). For the rating of elicited emotions, there was only a significant difference for disgusted ($p = 0.017$), with the 100 % scoring significantly higher than 75 % blend (Table S4). Five of the 18 sensory attributes were significantly different between the wines. For attribute citations, significant differences were found for ashy ($p = 0.012$), chemical ($p = 0.033$), smoky ($p < 0.001$), tobacco ($p < 0.001$), and woody ($p = 0.008$) (Table S5). For ashy ($p = 0.012$), the 100 % wine had significantly higher citations than the 0 % wine. For chemical ($p = 0.033$), the 0 % wine had significantly higher citations than the 50 % wine. For smoky ($p < 0.001$), the 100 % had significantly higher citations than the 0 % and 25 % wine, while the 75 % wine had significantly higher citations than the 0 % wine. For tobacco ($p < 0.001$) and woody ($p = 0.008$), the 100 % wine had significantly higher citations than the 0 % and 25 % wine.

3.2.1. Clustering

AHC indicated two distinct clusters of participants based on their liking of the 100 % smoke-impacted wine (Fig. S2). Cluster 1, defined as smoke-dislikers, with an average liking score of 3.26 out of 9-points and cluster 2, smoke-likers, with an average liking score of 6.86. Overall, the smoke-disliker cluster rated their liking of all the wine blends significantly lower than the smoke-likers (Fig. 2). Within both clusters, there was a significant difference between the 100 % and the other blends.

Smoke-dislikers cluster included 87 participants (61 female, 26 male, age 42.3 ± 14.3) and Smoke-likers cluster included 110 participants (67 female, 43 male, age 44.2 ± 13.1). Both clusters had similar consumption frequency of red wine, with 87 % of participants in each cluster consuming red wine at least once a month.

Further defining these clusters, significant differences in self-reported liking scores for smoke flavours in foods and beverages were found, with smoke-likers scoring significantly higher than the smoke-dislikers. Additionally, smoke-likers had significantly higher subjective wine knowledge scores for four of the five questions (Table 1). No other survey information collected significantly differed between the clusters.

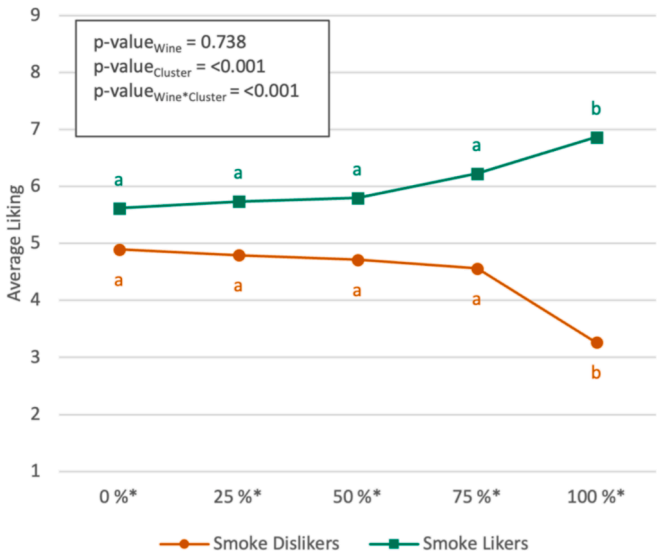

Fig. 2. Average liking scores within each cluster for wine blends (% represents the smoke-impacted wine in the dilution). Different letters indicate significant difference between samples within the cluster based on Tukey HSD (α = 0.05). * indicates significant difference between clusters for that wine sample.

3.2.2. Emotions by cluster

When analysing the differences in emotion intensity between and within the clusters, significant differences were observed for the interaction between sample and cluster for curious ($p < 0.001$), disgusted ($p < 0.001$), displeased ($p < 0.001$), excited ($p < 0.001$), happy ($p < 0.001$), interested ($p < 0.001$), nostalgic ($p = 0.011$), relaxed (<0.001), satisfied ($p < 0.001$), and worried ($p = 0.046$) (Table S6). Fig. 3 shows the interaction plots for these significant emotions (p-value sample*cluster < 0.05). Emotions with high valence and arousal (curious, excited, happy, interested, relaxed, satisfied) show strong association with liking, with opposing trends observed between the clusters. Interestingly, the smoke-liker cluster did not differ in their excitement towards any of the samples, whereas the dislikers showed a decreasing trend with the 0 % significantly higher than the 100 %. Emotions with low pleasure (disgusted, displeased) also showed opposing trends, negatively related to liking. For nostalgic and worried, there were no differences observed between the wines within each cluster, however, differences were observed between the clusters. For nostalgic, at the 50 % blend and above, the smoke-likers indicated significantly higher intensity of this emotion than the disliker cluster. For worried, the 100 % smoke-impacted wine elicited a significantly higher intensity of this emotion for the smoke-dislikers cluster.

3.2.3. Attributes by cluster

Significant differences were observed for the interaction between sample and cluster for astringent ($p = 0.029$), bitter ($p < 0.001$), chemical ($p = 0.030$), floral ($p = 0.048$), red fruit ($p = 0.011$), smoky ($p = 0.023$), and smooth ($p < 0.001$) (Table S7). Fig. 4 shows the interactions for these significant attributes (p-value sample*cluster < 0.05). Within each cluster, attribute citation did not differ for either cluster for astringent, chemical and floral. For red fruit and smooth, differences between the wines were only found for the smoke-disliker cluster. Within this cluster, the 100 % smoke-impacted wine had significantly lower citation frequency of red fruit than the 0 % and 25 % blends, while citation of smooth was significantly lower in the 0 %, 25 %, and 50 % blend. Differences between the wines were observed within both clusters for bitter and smoky. For the smoke-liker cluster, the citation frequency of bitter was significantly lower for the 100 % blend than the 0 %, while for the smoke-dislikers the 50 % blend was significantly lower than the 100 % blend. For smoky, the smoke-liker cluster indicated the 100 % had a higher citation than the 25 %, while the smoke-disliker cluster the 100 %, 75 %, and 50 % were significantly higher than the 0 %. The citation frequency of the attributes in the wines overall did not differ between clusters, except in the 100 % wine for the significant attributes with the smoke-dislikers citing significantly lower for floral, red fruit and smooth, and significantly higher for astringent, bitter and chemical. The 50 % wine differed between clusters for astringent and chemical, with the smoke-disliker cluster having higher citations, while the 0 % differed for smoky flavour, with the smoke-liker cluster having higher citations. Wines were found to be significantly different for ashy ($p = 0.022$), tobacco (<0.001) and woody (0.024), but there was no significant interaction.

Penalty-lift analysis provided further insights into differences between the two clusters based on drivers of liking for the blends (Table 2). Across clusters, astringent, bitter, chemical and metallic had significant negative impact on liking, while dark fruit, floral, red fruit and smooth positively impacted liking. For the smoke-disliker cluster, ashy and tobacco negatively impacted liking. For the smoke-liker cluster, sour negatively impacted liking while viscous positively impacted liking. Across clusters, smoky flavour had no significant positive nor negative impact on overall liking.

3.2.4. Multiple factor analysis by cluster

The MFA considering liking, emotions and sensory attributes for each cluster is presented in Fig. 5. Factor 1 (77.09 %) and factor 2 (11.30 %) explained 88.39 % of the total variance in the data set. For the smoke-liker cluster (Fig. 5B), liking was associated with curious, excited, happy, interested, nostalgic, relaxed, satisfied and secure as well as ashy, dark fruit, earthy, floral, red fruit, smoky, smooth, tobacco and woody attributes. For the smoke-disliker cluster (Fig. 5A), liking was associated with the same positive emotions, but was only associated with dark fruit, floral, herbaceous, red fruit and smooth attributes. When looking at the separation of the sample observations, the 100 % blend fell on the positive end of F1, which is strongly related to ashy, smoky, tobacco and woody within both clusters (Fig. 5C).

3.3. Label concepts

Across the label concepts, there was no significant difference in liking (Table 3). For emotions, significant differences were found between the four label concepts for curious ($p = 0.024$), interested ($p = 0.023$) and sad ($p < 0.001$). The Unity concept showed significantly higher interest than the 2020 concept, along with a significantly higher sad rating than all of the concepts. Based on the conservative Tukey HSD test, there were no significant pairwise differences found for curious despite a significant p-value. For the sensory attributes, metallic, smoky and woody were found to be significantly affected by the labels (Table 4). Metallic citation was significantly higher for the Unity label than both 2018 and 2020 concepts. Smoky citation was significantly higher for the Smoke Stack label than all of the other concepts, while woody citation was significantly higher for the Smoke Stack label compared to the Unity label.

3.3.1. Blind condition (unlabelled) versus informed conditions (labelled) by cluster

3.3.1.1. Liking. Liking scores did not differ when comparing the blind condition (100 % smoke-impacted wine from part 1) versus the informed conditions for the smoke-liker cluster, but differences were found for the smoke-disliker cluster (Fig. 6) with liking increasing when labels were presented. With the inclusion of the label concept, the liking of the smoke-impacted wine increased significantly in the smoke-disliker cluster, with no differences found between the label concepts. Overall, the liking scores between the clusters across all conditions was significantly higher for the smoke-liker cluster.

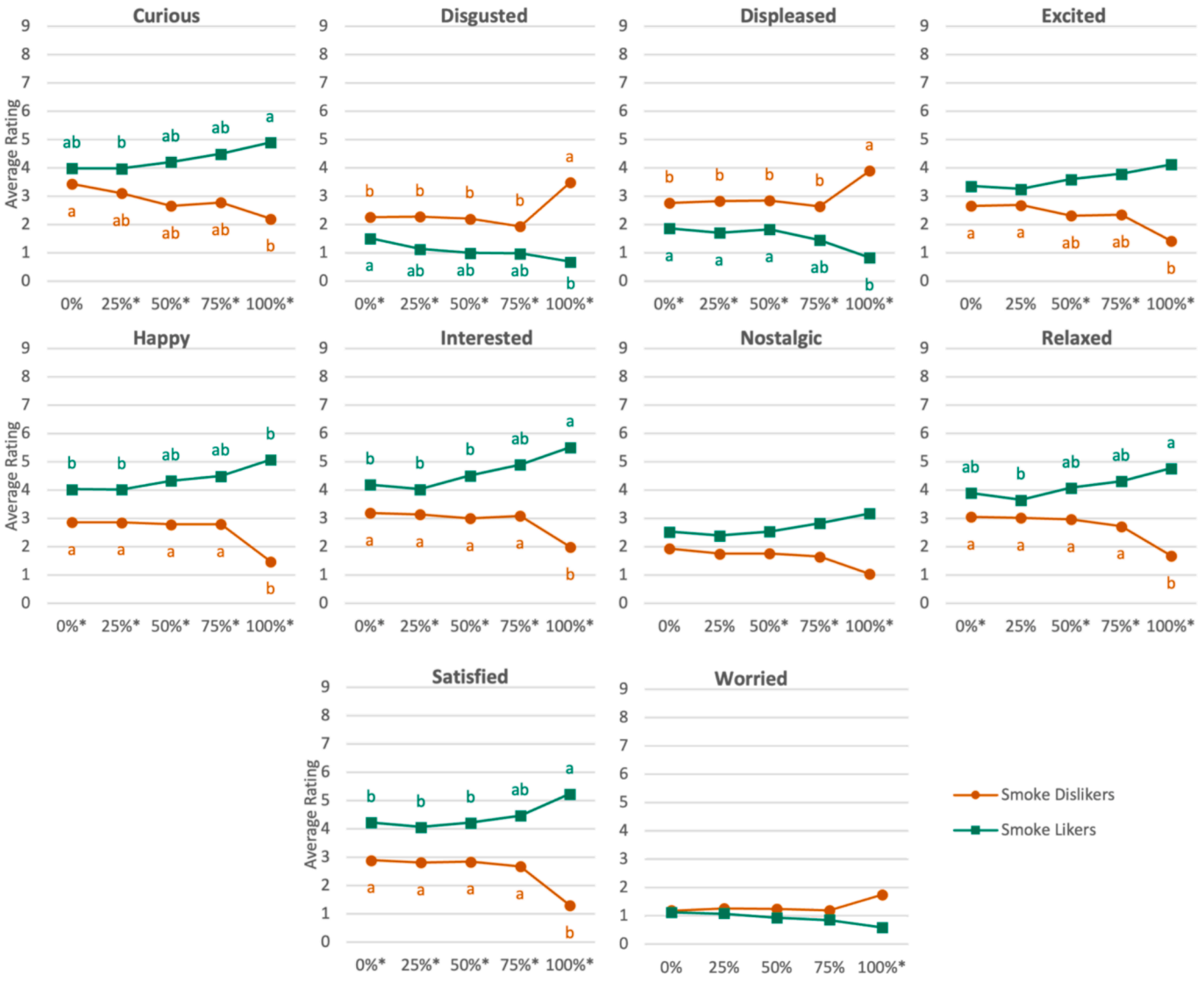

Fig. 3. Average ratings for wine blends (% represents the smoke-impacted wine in the dilution) within each cluster for the emotions with significant interaction. Different letters indicate significant difference between samples within the cluster from Tukey HSD ($\alpha = 0.05$). * indicates significant difference between clusters for that wine sample.

3.3.1.2. Emotion. When analysing the differences in emotion intensity between and within the clusters, a significant sample*cluster interaction was observed for curious ($p = 0.006$), disgusted ($p < 0.001$), displeased ($p < 0.001$), excited ($p = 0.009$), happy ($p < 0.001$), interested ($p < 0.001$), indifferent ($p < 0.001$), nostalgic ($p = 0.046$), relaxed ($p < 0.001$) and secure ($p = 0.030$) (Table S8). Fig. 7 shows the interactions for these significant emotions. For the smoke-liker cluster, emotions only differed between the label conditions for indifferent and interested. For the smoke-dislikers, emotions with high valence and arousal (curious, excited, happy, interested, relaxed, satisfied) were higher in the informed label conditions compared to the blind condition. Emotions with low pleasure and arousal (disgusted, displeased, indifferent) were significantly reduced by the presence of a label concept compared to the blind condition. For nostalgic and secure, there were no differences observed between the wines within each cluster, however, differences were observed between clusters. For nostalgic, the smoke-likers had a significantly higher rating than the smoke-dislikers for all label conditions except the Smoke Stack concept, which was not significantly different. For secure, the smoke-liker cluster had a significantly higher rating than the smoke-dislikers for all label conditions.

3.3.1.3. Attributes. Significant sample*cluster interactions were observed for bitter ($p = 0.004$), chemical ($p = 0.015$), floral ($p = 0.004$), red fruit ($p = 0.011$) and smooth ($p < 0.001$) (Table S9). Fig. 8 shows the interactions for these significant attributes. Within the smoke-liker cluster, differences were only observed for the metallic attribute, with the Unity label concept having a higher citation than the 2018 label. For the smoke-disliker cluster, red fruit and smooth were significantly increased with the presence of a label over the unlabelled condition, whereas bitter was significantly reduced. Chemical was reduced by the presence of a label concept, except for the 2018 label which was not significantly different than the unlabelled condition. Floral was only significantly increased for the Unity label concept over the unlabelled wine.

3.3.1.4. Multiple factor analysis. Factor 1 (67.15 %) and factor 2 (15.11 %) explained 82.27 % of the total variance in the data set (Fig. 9). The biplot shows that for the smoke-disliker cluster (Fig. 9A), liking was associated with curious, excited, happy, interested, nostalgic, relaxed, satisfied and secure as well as floral, metallic, pepper, smoky and sour attributes. For the smoke-liker cluster (Fig. 9B), liking was associated with bored, curious, excited, guilty, happy, indifferent, interested,

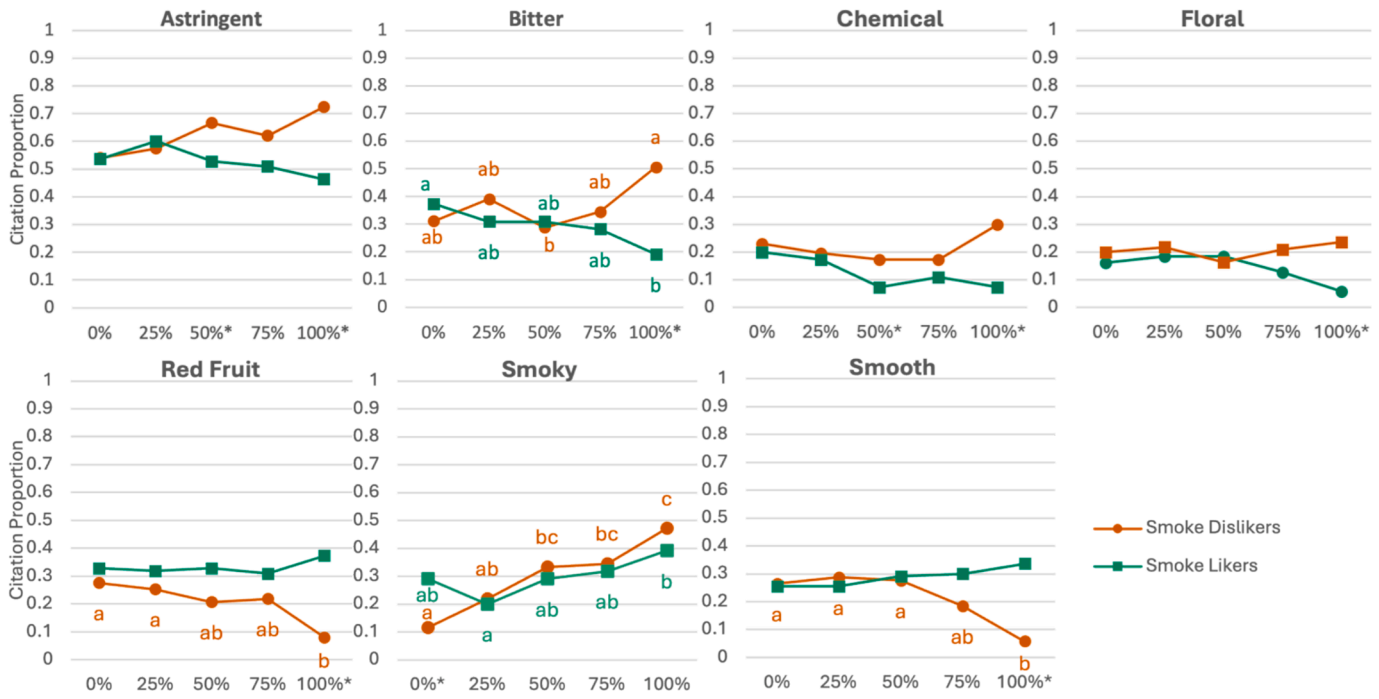

Fig. 4. Citation proportions for wine blends (% represents the smoke-impacted wine in the dilution) within each cluster for attributes with significant interaction. Different letters indicate significant difference between values within the cluster from Tukey HSD (α = 0.05). * indicates significant difference between clusters for that wine sample.

Table 2
Results from Penalty/Lift analysis with attribute citation proportion across wine blends and mean impact on liking when CATA attribute was selected for each cluster.

Attribute	Smoke dislikers		Smoke likers	
	Citation proportion	Mean impact	Citation frequency	Mean impact
Ashy	0.244	−1.188***	0.136	−0.35
Astringent	0.625	−1.063***	0.527	−0.593***
Bitter	0.368	−1.220***	0.293	−0.860***
Chemical	0.214	−1.402***	0.126	−1.415***
Dark Fruit	0.329	1.419***	0.355	0.647***
Earthy	0.278	0.046	0.258	0.029
Floral	0.143	2.000***	0.206	0.974***
Herbaceous	0.089	0.721N/A	0.147	0.087
Metallic	0.17	−1.026***	0.116	−1.205***
Pepper	0.175	−0.206	0.204	−0.017
Red Fruit	0.207	1.763***	0.331	0.715***
Smoky	0.297	−0.358	0.298	0.052
Smooth	0.214	1.758***	0.287	1.254***
Sour	0.418	−0.361	0.353	−0.785***
Spice	0.099	0.589N/A	0.175	0.370*
Tobacco	0.166	−1.034***	0.124	−0.224
Viscous	0.101	0.338	0.124	0.531*
Woody	0.32	0.307	0.389	0.187

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.
N/A Significance not calculated if citation frequency below 10%.

nostalgic, relaxed, satisfied and secure as well as with ashy, smooth, tobacco, viscous and woody attributes. When looking at the separation of the sample observations, the differentiation is driven by label concepts being presented or not. The unlabelled condition is positioned at the negative pole of the F1 axis while all of the label conditions are at the positive pole. (Fig. 9C). The F2 axis related to amount of information, with the Unity and Smoke Stack labels positioned at the positive pole, and the vintage only labels, therefore less informative concepts, at the negative pole.

4. Discussion

4.1. Blends of smoke-impacted and non-impacted wine

4.1.1. Liking and consumer clustering

Previous research found that consumers overall disliked smoke-impacted wine. This study revealed no differences in liking between the smoke-impacted and non-impacted wine, including their blends. However, it is important to consider that other studies have examined different populations and grape varietals, such as Americans for Cabernet Sauvignon (Oberholster et al., 2023) and Australians for Shiraz, Pinot noir rosé and Chardonnay (Bilogrevic et al., 2023). This highlights the importance of understanding the effects of both differences in varietal and wine style, as well as the consumer population when assessing acceptance of wildfire-impacted wines.

No differences were found when looking at consumers overall, however, key findings can be hidden when averaging across all participants. Use of clustering participants provided deeper insights into liking patterns of smoke impacted wine. Although all participants were red wine consumers, red wines tend to evoke a broad sensory profile. This results in varied consumer responses, similar to trends observed in other alcoholic beverage categories, like in beer for instance (Jaeger et al., 2020). In the present study, two clusters of consumers were found, differentiating likers of the smoke-impacted wine from dislikers. Previous work has identified three clusters based on their responsiveness to smoke flavour (Bilogrevic et al., 2023). In the current work, however, the majority fell into the likers cluster, differing from findings in other consumer populations. Overall, the dislikers rated all wines significantly lower, with the smoke-impacted wine showing a significant drop in liking compared to the other wines.

In addition to differing in liking, the clusters exhibited other distinguishing characteristics. The smoke-liker cluster reported a significantly greater appreciation for smoke flavours in foods and beverages than the disliker cluster. This suggests that predispositions toward flavour preferences in other categories can impact acceptance in wine. Furthermore, the smoke-likers had significantly higher subjective

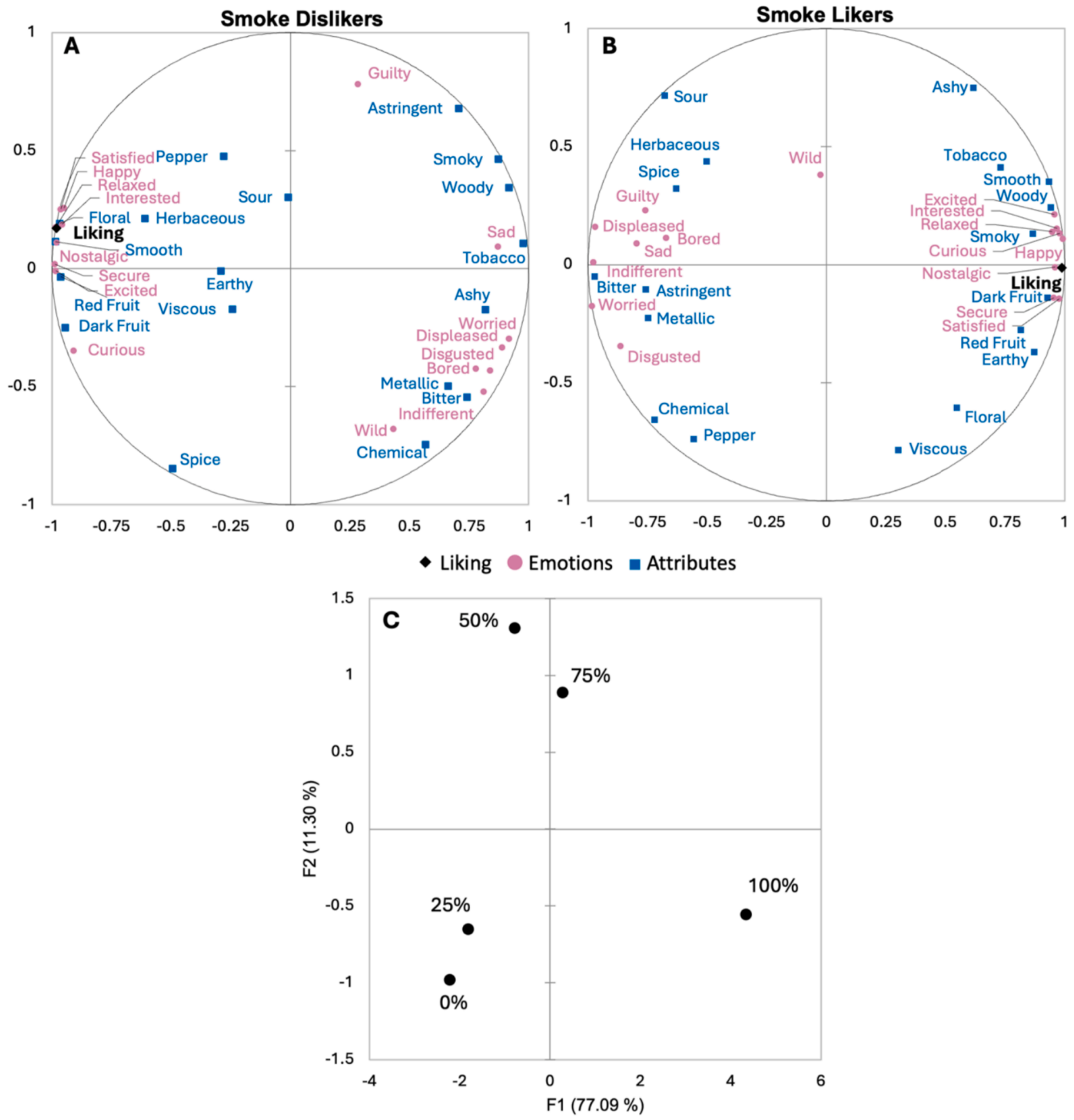

Fig. 5. (A and B) Multiple factor analysis (MFA) F1/F2 plots, accounting for 88.39% total variance across the first two factors. Liking (black diamond), emotions (pink circles), and sensory attributes (blue squares) loadings. (C) Active observations (smoke-impacted wine dilutions).

knowledge, having significantly higher ratings in four of the five categories evaluated. Consumer knowledge comprises their level of familiarity and expertise with a product category, which is related to their level of involvement with a product (Bruwer et al., 2014; Guo & Meng, 2008; Lesschaeve & Bruwer, 2010). This aligns with the idea that consumers with varying levels of expertise and involvement rely on different cues when evaluating wine quality (D'Alessandro & Pecotich, 2013). While the relation of wine knowledge and liking of smoke-impacted wine was unexpected, this further indicates how level of knowledge relates to consumer evaluation of wine.

4.1.2. *Emotional response by cluster*

Emotions with high valence (curious, excited, happy, interested, nostalgic, relaxed, satisfied, secure) were associated with higher liking scores for both clusters, which is supported in other studies examining emotional responses to wines (e.g. Danner et al., 2016; Mora et al., 2021; Ristic et al., 2019). However, which wine evoked these emotions differed between the clusters, as with liking. The positive emotions were associated with the smoke-impacted wine for the liker cluster, while for the smoke-disliker cluster they were related to the non-impacted wine. To contrast this, lower valence emotions (bored, disgusted, displeased, indifferent, sad, worried) were more related to the less liked wines within each cluster. For the smoke-liker cluster, guilty was more

Table 3
Average ratings for liking and emotions for the smoke impacted wine presented with the four label concepts, and p-values from ANOVA. Samples with different superscript letter in the same row are significantly different according to Tukey's HSD (α = 0.05). **Bolded** p-values indicate significance at 95 % confidence level.

	2018	2020	Smoke Stack	Unity	p-value
Liking	5.761	5.827	5.888	5.959	0.496
Bored	1.112	1.036	1.132	1.081	0.873
Curious	3.726[a]	3.706[a]	4.020[a]	4.117[a]	**0.024**
Disgusted	1.178	1.315	1.142	1.208	0.523
Displeased	1.462	1.508	1.477	1.477	0.992
Excited	3.127	3.305	3.198	3.325	0.558
Guilty	0.599	0.609	0.665	0.711	0.556
Happy	3.766	3.817	3.883	3.893	0.857
Indifferent	0	0.005	0.051	0.066	0.260
Interested	4.036[ab]	3.970[b]	4.137[ab]	4.452[a]	**0.023**
Nostalgic	2.492	2.482	2.477	2.364	0.788
Relaxed	3.553	3.66	3.69	3.579	0.809
Sad	0.716[b]	0.690[b]	0.838[b]	1.239[a]	**<0.001**
Satisfied	3.756	3.995	3.939	3.914	0.559
Secure	3.005	3.137	3.107	3.127	0.812
Wild	1.716	1.827	1.812	1.594	0.214
Worried	0.822	0.914	0.832	1.041	0.146

Table 4
Citation proportion of sensory terms and p-values from Cochran's Q test for the smoke impacted wine presented with the four label concepts. Samples with different superscript letter in same row are significantly different according to Sheskin procedure (α = 0.05). **Bolded** p-values indicate significance at 95 % confidence level.

Attribute	2018	2020	Smoke Stack	Unity	p-value
Ashy	0.168	0.147	0.157	0.127	0.602
Astringent	0.503	0.518	0.589	0.569	0.075
Bitter	0.244	0.223	0.239	0.279	0.475
Chemical	0.117	0.086	0.096	0.127	0.397
Dark	0.426	0.391	0.401	0.371	0.571
Earthy	0.299	0.274	0.325	0.269	0.451
Floral	0.193	0.183	0.132	0.228	0.051
Herbaceous	0.102	0.112	0.132	0.142	0.386
Metallic	0.086[a]	0.086[a]	0.142[ab]	0.173[b]	**0.006**
Pepper	0.178	0.218	0.198	0.218	0.585
Red	0.345	0.335	0.315	0.371	0.573
Smoky	0.289[b]	0.299[b]	0.437[a]	0.244[b]	**<0.0001**
Smooth	0.289	0.299	0.239	0.31	0.269
Sour	0.365	0.355	0.31	0.35	0.444
Spice	0.142	0.152	0.147	0.162	0.925
Tobacco	0.132	0.152	0.168	0.117	0.359
Viscous	0.086	0.102	0.102	0.071	0.557
Woody	0.411[ab]	0.411[ab]	0.462[b]	0.330[a]	**0.012**

associated with disliking and the negative valence emotions compared to the smoke-liker cluster. This smoke-liker group indicated they were more knowledgeable and had greater confidence in their ability to identify quality wine. This suggests that more guilt is felt towards what they assume is a lower quality, and therefore less liked wine.

Emotions such as curious and excited were elicited similarly by the non-impacted wine for both clusters. While the smoke-liker group remained similarly excited and curious for all wines, the excitement towards the wine was significantly reduced as level of smoke-impacted wine increased for the dislikers. Consumers with a higher wine involvement tend to have a greater appreciation for novel sensory experiences in wine, whereas those less involved are looking for consistency (Charters & Pettigrew, 2007). This suggests these smoke-related flavours in wine may not be as problematic for a more knowledgeable consumer group, with the excitement for the product remaining and curiosity slightly peaked. This, however, needs to be confirmed in additional vintages and understood in other wine varieties, styles, and levels of smoke-exposure, as the expression of these flavours in different conditions may not be as appreciated.

4.1.3. Sensory attributes by cluster

The smoke-related attributes (smoky, ashy and tobacco) were rated similarly between the clusters across the blends, indicating the smoke-impacted wine had higher prevalence of these attributes. This was expected, as these attributes are considered indicator of wildfire smoke-exposure in wine (Høj et al., 2003). Previous work has shown that some individuals may not perceive these attributes (Parker et al., 2012), however the present work shows that these clusters were not defined by difference in smoke attribute perception, with the wines being similarly differentiated. Surprisingly, smoky flavour was not identified to have a significant impact on liking in either cluster. While smoky flavour is often used as a key indicator of smoke taint in wine, it is not an uncommon flavour in red wines due to its introduction from oak contact (Parker, Jiang, Siebert, & Herderich, 2024; Prida & Chatonnet, 2010; Veríssimo, de Macêdo Morais, de Andrade Lima, Pereira, & Maciel, 2021). This suggests that while smoky flavour can indicate wildfire exposure, it is not necessarily linked to consumer dislike. Other smoke-related attributes, ashy and tobacco, were drivers of disliking for the smoke-disliker cluster in this work. When considering consumers response to a smoke-impacted wine based on sensory attributes, intensity of ashy and tobacco flavours may better predict consumer acceptance and/or rejection.

Floral, red fruit, and smooth, which were all positive drivers of liking for both clusters, had significantly lower citations in the smoke-impacted wine for the disliker cluster. Additionally, red fruit and smooth differentiated the non-impacted wine from the impacted wine for this cluster, whereas the smoke-liker cluster found these attributes to be consistent between wines. Previous work has shown that these positively regarded flavours are less intense in smoke-impacted wines, being masked by the smoke introduced components to the chemical matrix and perceptually by negative distractors (Kelly & Zerihun, 2015; McKay, Bauer, Panzeri, & Buica, 2020). This suppression effect is a result of the different valence of the components, with the less pleasant attributes suppressing the perception of the pleasant ones (Ferreira et al., 2021). Since ashy and tobacco were only negatively regarded by the disliker cluster, this suppression effect only influenced this group. This indicates that some of this masking may be due to hedonic associations to specific flavours, which are based on individual consumer preferences.

4.2. Labels

4.2.1. Consumer response to different label concepts

Although no differences in liking were found for the label concepts across all participants, emotional responses did differ. Curious, interested and sad were significant differentiators when the wine was evaluated with different label concepts. Expectation plays a key role in curiosity, indicating that as expectations change based on the label information, both curiosity and interest are impacted (Spinelli, Masi, Zoboli, Prescott, & Monteleone, 2015).

When the Unity concept was presented, sad was significantly higher on average. A dimension of expectation that can be shaped by the label is ideation, which refers to the anticipation that a product will evoke a specific emotional response (Cardello, 2007). When this emotional expectation is set by the label, it influences the overall emotional evaluation of the product, as seen when describing an emotionally loaded scenario. This can elicit empathy from the consumer, with them matching the emotion of the subject (Johnson, 2012). In eliciting negative feelings, this can result in positive attitudes, evaluations and behaviours (Zheng, 2020). However, in this work there was no change in acceptance of the wine with the label concept presented. Further research is needed to understand if these differences in elicited emotions and attention translates into differences in purchase intent and/or willingness to pay.

Product descriptions and labelling can be precursors to the sensory attributes of a product, leading sensory perception to conform to the

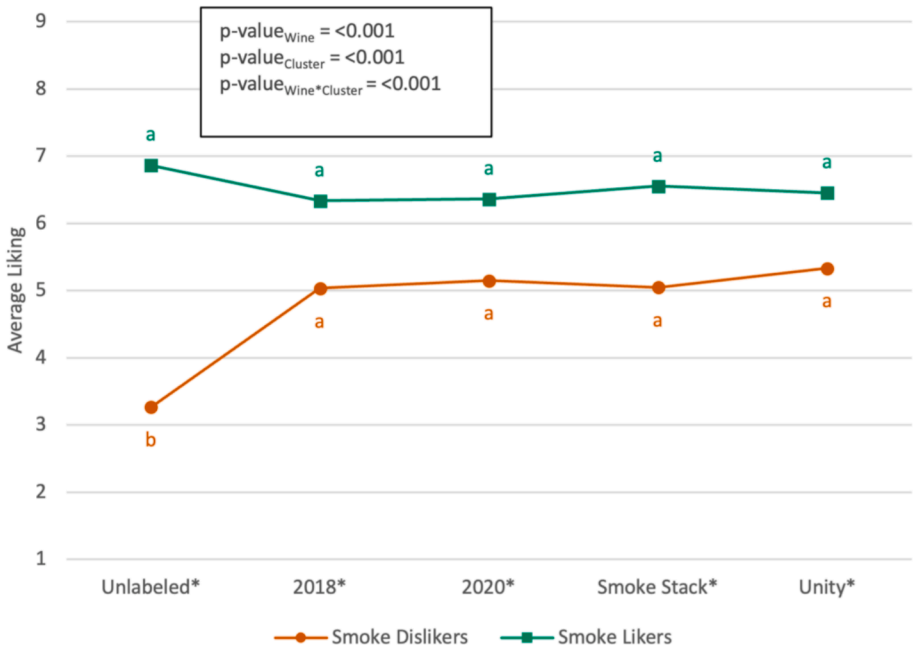

Fig. 6. Average liking scores of 100 % smoked-impacted wine within each cluster when presented with label concepts (2018, 2020, Smoke Stack and Unity) and unlabeled. Different letters indicate significant difference between values within the cluster based on Tukey HSD ($\alpha = 0.05$). * indicates significant difference between clusters for that wine sample.

description (Liem et al., 2012). This is based on the assimilation psychological model from the expectation created. This model describes how sensory experiences are modified towards the expectation created to minimise the difference between expectation and experience to reduce "mental discomfort" (Okamoto & Dan, 2013). When the wine was described as smoky, both in description and name as seen with the Smoke Stack label, the prevalence of smokiness was increased since that expectation was established. The dissonance occurs if this attribute is not experienced by an individual but is selected anyway due to distrust in their palate and desire to be "correct", along with potential neurological changes in perception (Veale & Quester, 2009; Woods et al., 2011). While the sensory cues provided on labels can influence perception, this is not necessarily linked to informed liking, as it was seen that the Smoke Stack label was equally liked. This finding further supports that smoky was not an inherently negative attribute, nor a driver of liking or disliking.

4.2.2. Informed conditions (labels) versus blind condition (unlabelled) by cluster

4.2.2.1. Liking. When comparing the wine presented with the labels to the same wine presented blind in the first portion of the study, liking increased for the smoke-disliker cluster but remained unaffected in the smoke-liker cluster. Consumers tend to be more attracted to extrinsic cues (Liu et al., 2022). However, as seen here, this can be related to an individual's level of knowledge. More experienced consumers have been found to evaluate a wine based on grape variety and their liking of the wine in a blind condition (Mueller & Szolnoki, 2010). As liking remained consistent, it is likely that this effect was observed in the present study as wines were indicated to be from the same grape varietal. It has also been found that higher involvement consumers rely more on wine's intrinsic attributes, while less involved depend more on the extrinsic cues (Dodd, Laverie, Wilcox, & Duhan, 2005). For the smoke-disliker cluster, as they had a lower level of knowledge, this suggests that they may have placed a greater importance on these extrinsic properties in evaluating the wine and, in this case, it positively impacted their overall experience.

4.2.2.2. Emotions. For the smoke-dislikers, positive emotions were more strongly evoked in the informed conditions. Consumers with lower expertise are generally more inclined to have a positive feeling when given greater levels of information (Coppin et al., 2021). As this cluster indicated they had lower confidence in their wine knowledge, it would be expected that greater positive feelings would be evoked in the informed condition. As stated, labels set up an expectation for the consumer, giving them a prior indication of how they might like or feel about the product. This can then lead to complete assimilation of liking, where informed liking is more similar to expected liking than the liking in a blind condition (Caporale et al., 2006). This then influences emotions, increasing positive ones and decreasing those negative. While expectation of liking prior to tasting was not collected in this work, this suggests that understanding this expectation is important in consumer acceptance of smoke-impacted wines.

For smoke-likers, none of the presentation conditions of the smoke-impacted wine were strongly related to displeasure, further indicating the stability of liking compared to the blind condition. As seen in the MFA, sad, worried and disgusted were associated with the Unity label concept. Emotional response to wildfires in general has been found to be predominantly negative, as expected, eliciting emotions like sadness, disgust, fear and anger (Loureiro et al., 2022). This further indicated the effects of ideation expectations with this label, as these events are known to have this emotional associations.

Bored and indifferent, while generally considered negative valence emotions, were related to liking when considering blind and informed tasting conditions for the smoke-likers. More knowledgeable consumers generally evaluate their liking based on sensory properties (Dodd et al., 2005). While the smoke-liker cluster recognised that the presence of the label concepts decreased boredom and indifference, this did not translate to a change in liking when the sensory properties remained the same. In certain circumstances, those with higher wine knowledge can view extensive label descriptions unfavourably (Pickering, Duben, & Kemp, 2022). While this did not impact their liking of the wine nor the wines being found unpleasurable, it is important to find a balance between engaging less knowledgeable consumers and retaining those who inherently enjoy smoke-impacted wines.

Guilt for this smoke-liker cluster was also related to liking, contrasting with initial findings of this study which indicated a link to

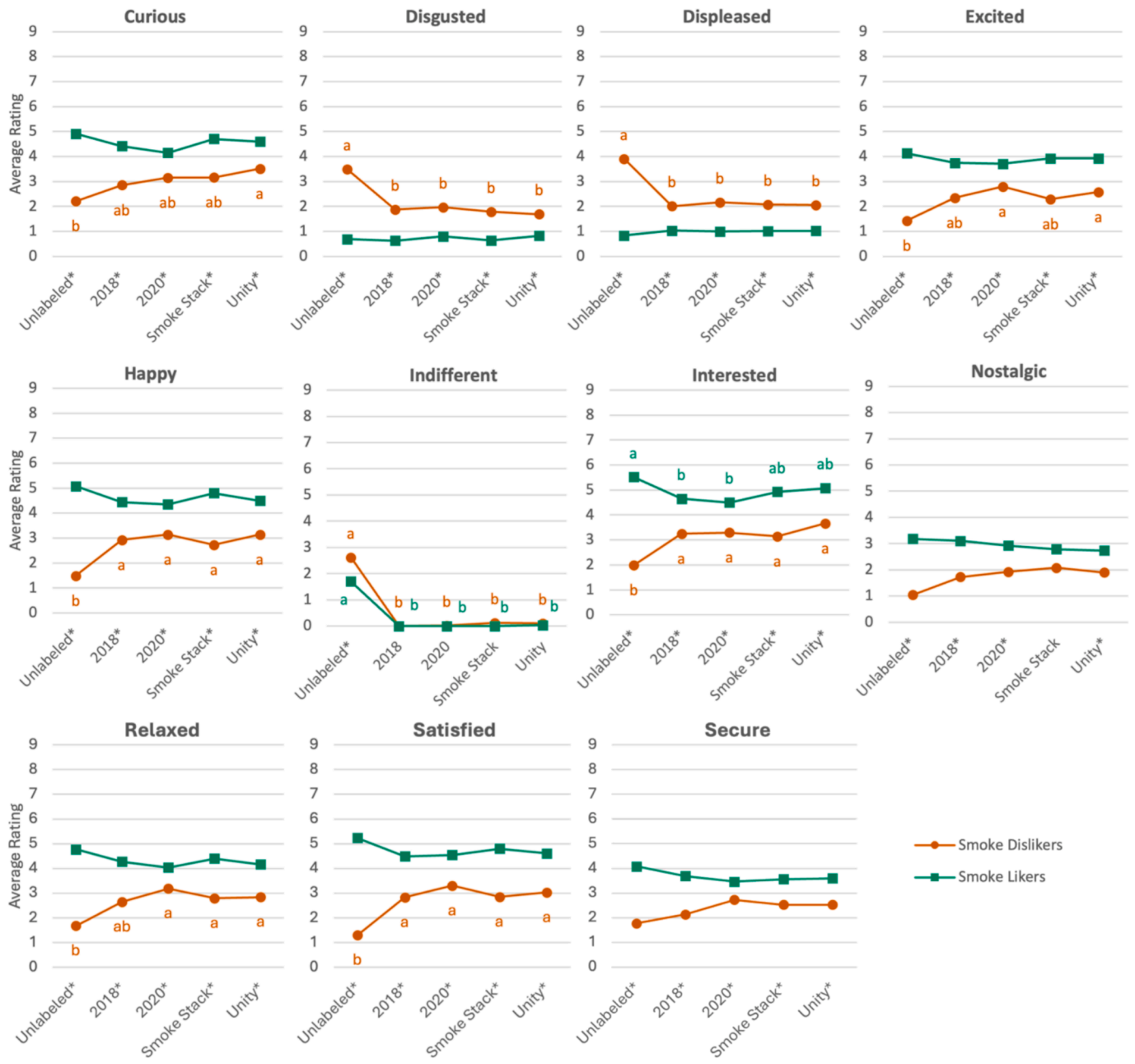

Fig. 7. Average ratings for each label concept and the blind condition (unlabeled) within each cluster for emotions with significant interaction. Different letters indicate significant difference between values within the cluster from Tukey HSD ($\alpha = 0.05$). * indicates significant difference between clusters for that wine label.

disliking. Since each of these wines was equally liked in the second part of this work, more guilty pleasure effect may have been observed. Guilt is often considered as a negative emotion, which inhibits socially undesirable behaviour but can also have a cognitive association with pleasure (Goldsmith, Cho, & Dhar, 2012; Tangney, Stuewig, & Mashek, 2007). In Gunaratne et al. (2019), guilty was associated to other positive emotions such as enjoyment and comforting. On the other hand, Dupas de Matos et al. (2025) found that guilty was culture dependent, with differences in positive or negative association depending on cultural differences between individuals. In the present study, results were depended on product set and whether a more disliked wine was included. This dichotomy of guilt is a factor that needs to be considered in future wine consumer research, as it can be the result of both positive and negative feelings towards a wine depending on various factors.

4.2.2.3. Attributes. Attribute perception was relatively consistent between the blind conditions and the informed conditions for the smoke-liker cluster, whereas improvements were found for the smoke-disliker cluster. Bitter and chemical citations were significantly reduced in the informed condition, whereas floral, red fruit and smooth citations significantly increased. This suggests that some of the suppression effects seen in the smoke-impacted wine was mitigated by the assimilation effect present in the informed conditions. This implies that the masking properties of smoke is depend not only on the wine matrix but also on the perceptual and emotional responses that contribute to the total wine experience.

Additionally, the expectation effect on attribute perception is further highlighted in the MFA. Smoky flavour is positioned on the left side of the plot for both clusters, more related to liking for the dislikers than the likers, contrary to what would be expected. The expectation set up by the "Unity" and "Smoke Stack" label concepts shifted this attribute to be more related to these label concepts than liking for the smoke-likers,

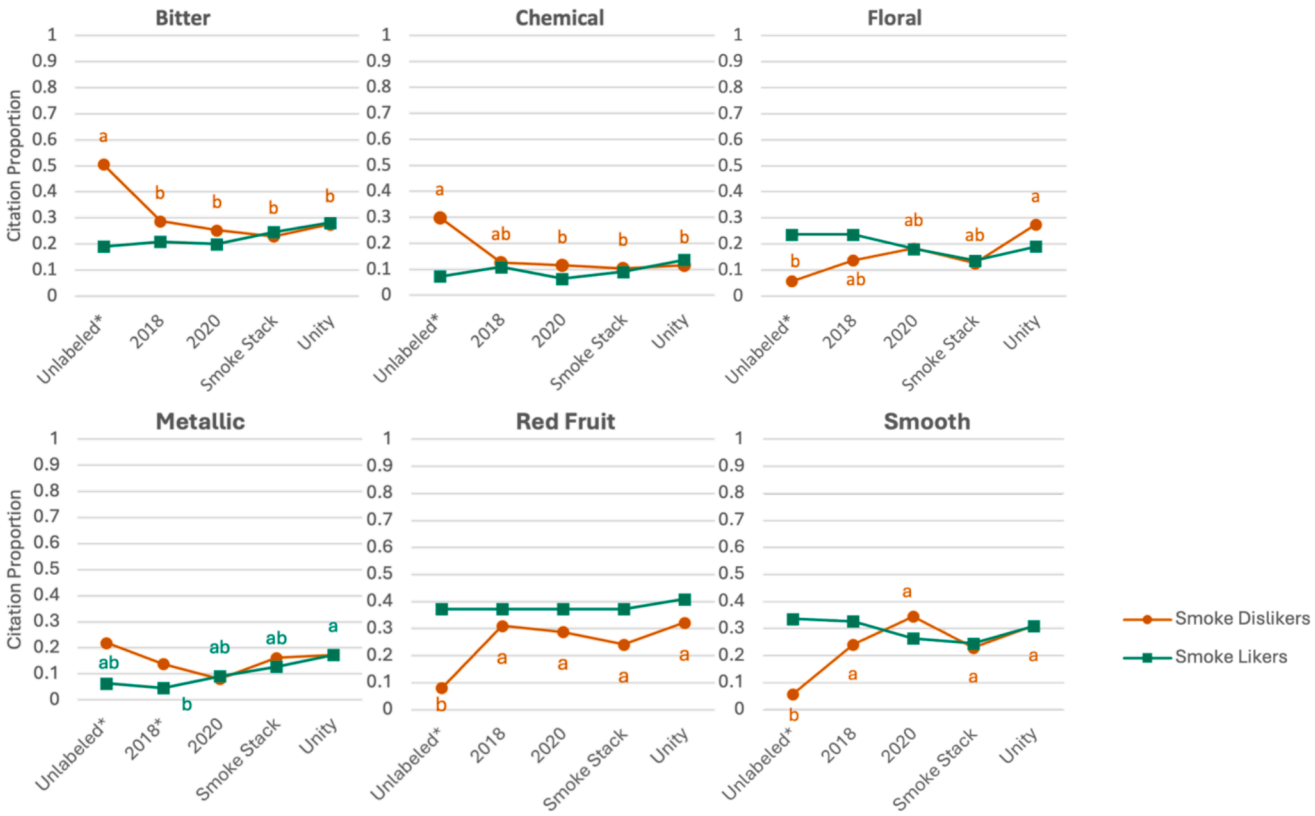

Fig. 8. Citation proportions for label concepts and the blind condition (unlabeled) within each cluster for attributes with significant interaction. Different letters indicate significant difference between labels within the cluster from Tukey HSD ($\alpha = 0.05$). * indicates significant difference between the clusters for that label.

which had the highest, while non-significant, score for the unlabelled condition. For the dislikers, a similar effect is observed, however, liking was significantly higher with the label concepts, making smoky attribute more related to liking. A key differentiation between the clusters in the realm of smoke impacted wine is that the ashy attribute was still associated with liking for the liker cluster but not the disliker cluster.

4.3. Limitations

The findings of this study offer valuable insights into consumers response to smoke-impacted wine, however some limitations warrant consideration. Firstly, the consumer population studied is relevant. As noted, New Zealand has not faced the same wildfire impacts as other wine-producing regions. Consequently, consumers may not have the same awareness that consumers from those affected areas, potentially leading to differences in liking and emotional responses toward the wines in both the blind and informed conditions. Additionally, all consumers in this study were regular red wine drinkers, but there are significant varietal and style differences that could influence acceptance. While no differences in varietal consumption was observed between clusters (data not shown), this is an important consideration for future research. Grape varieties have differences in response to smoke exposure, which can affect how the smoke influence manifests in the resulting wine and how it relates to the typical characteristics of each varietal. Secondly, the labels used in this study were differentiated by level of information provided, but it remains unclear which specific elements contributed to the observed differences. These could include specific words, images or a more overall holistic effect. Future research should explore a wider range of concepts with a more systematic addition of elements to gain a better understanding of the underlying drivers. Additionally, technologies such as eye-tracking could be employed to more accurately observe these effects. While the labels were included to enhance ecological validity, gaps remain in understanding how perception of these wines change based on evaluation context, as it may be influenced by the consumption scenario and purchase location. Lastly, although information on wine knowledge was gathered, wine involvement has a different metric and was not collected. While these factors are often related, variation in wine involvement may provide further insights into how different consumers perceive and accept smoke-impacted wines.

5. Conclusion

Are wildfires effect on wine a defect or a characteristic of the vintage? As vintage differences are observed and expected in wine production based on environmental factors (e.g., level of rain, sun, wind, humidity), some types of smoke-exposure at low levels might contribute to vintage characteristics. In the present study, most local New Zealand consumers (n = 110) liked the smoked-impacted wine, with the smoke-liker cluster having an average liking score of 6.9 in the blind condition. It is important to understand how liking of smoke-impacted wine is consumer dependant, which then further relates to the elicited emotions and the sensory attributes experienced. While the smoke-disliker cluster disliked the wine when presented blind, both clusters rated the wine above 5 points ('neither like nor dislike') in the informed conditions. With the transparency of discussing smoke impact on the label, as seen with the Smoke Stack and Unity labels, liking was not impacted by these consumers. The expectation and curiosity elicited by the label concepts instead increased liking significantly for the smoke-dislikers cluster compared to the blind condition. This finding highlights the critical role of labelling in shaping ideation and expectation, which can influence liking, elicited emotions, flavour expectations, and ultimately purchase behaviour. In creating the emotional scenario or ideation with the Unity label, sadness was increased. In creating the expectation with the Smoke Stack label, the perceived smokiness was increased. These effects should be carefully considered when producing and marketing smoke-impacted

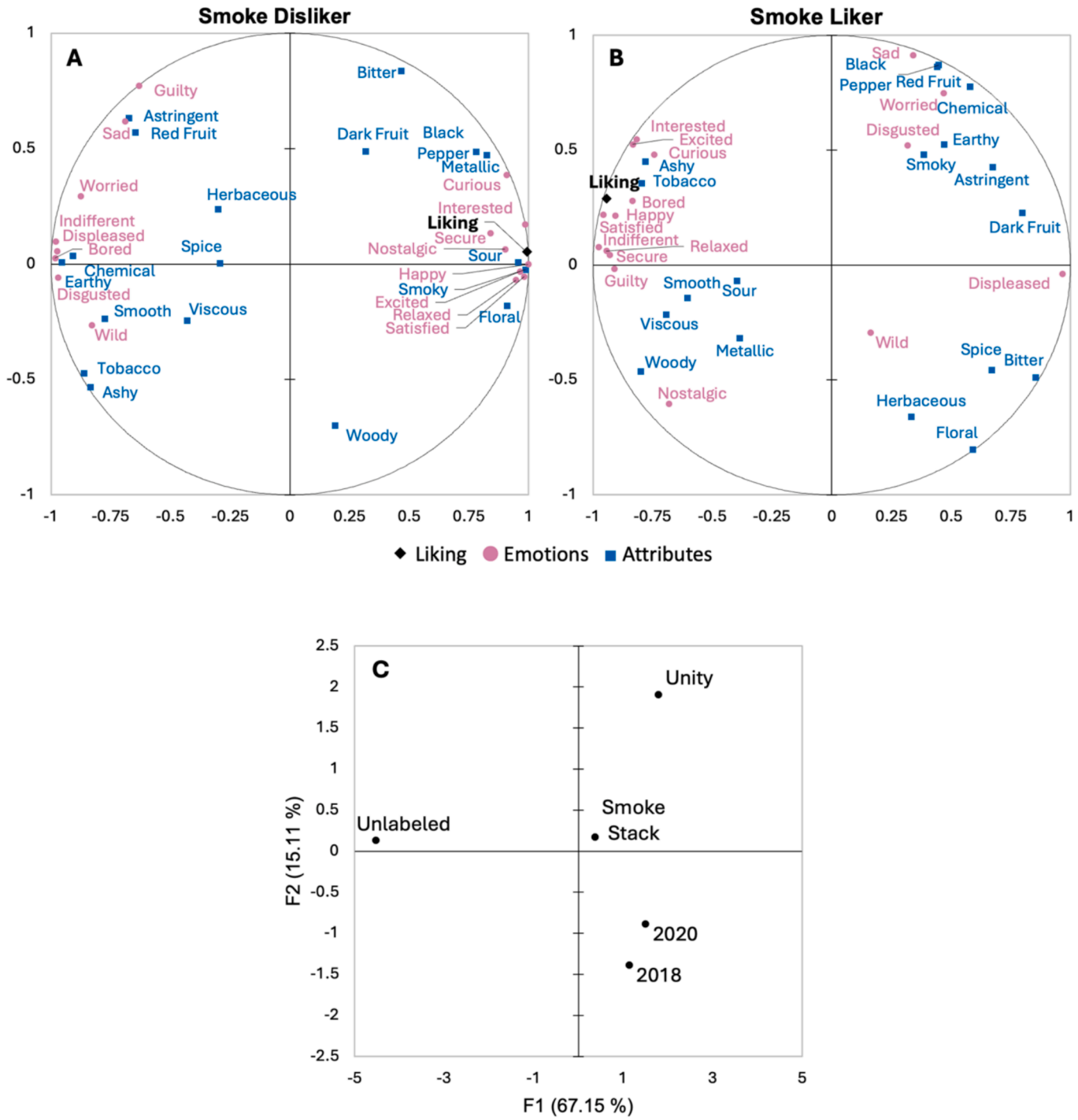

Fig. 9. (A and B) Multiple factor analysis (MFA) F1/F2 plot, accounting for 88.39% total variance across the first two factors. Liking (black diamond), emotions (pink circles), and sensory attributes (blue squares) loadings. (C) Active observations (label concepts and unlabeled).

wines. While transparency can contribute to product acceptance in certain consumer segments, if this attribute or emotion is not desired in other segments the wine may not be well accepted. Further research is needed to explore how different populations and wine styles correlate with these findings, as well as the effects of varying levels of smoke exposure in Pinot noir as well as in other grape varietals.

6. Agreement to publication

Authors declare that the results of the present work have not been submitted elsewhere or present conflicts of interests. Also, authors agree to all publication policies of Food Research International.

7. Declaration of generative artificial intelligence in scientific writing

Authors declare that they did not use any kind of AI or AI-assisted technology in the writing process.

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Ethical statement

The present project follows procedures from the Helsinki Declaration for research with humans and was approved by the Massey University Human Ethics Ohu Matatika 1 committee (Approval OM1 23/61).

CRediT authorship contribution statement

Jenna A. Fryer: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Amanda Dupas de Matos:** Writing – original draft, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Joanne Hort:** Writing – review & editing, Supervision, Resources. **Elizabeth Tomasino:** Writing – review & editing, Supervision, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodres.2025.115881.

Data availability

The experimental data obtained in the current study are available from the corresponding author on reasonable request.

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