



Barriers to consumption of plant-based beverages: A comparison of product users and non-users on emotional, conceptual, situational, conative and psychographic variables

Sara R. Jaeger^{a,*}, Davide Giacalone^b

^a The New Zealand Institute for Plant and Food Research Limited, Mt Albert Research Centre, Private Bag 92169, Auckland 1142, New Zealand

^b SDU Innovation & Design Engineering, Department of Technology and Innovation, University of Southern Denmark, Campusvej 55, 5230 Odense, Denmark

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ABSTRACT

Production and consumption practices that reduce the environmental burden of eating and drinking and promote global sustainability are of paramount interest. Against this background, we present a quantitative study of US adults' perceptions of selected non-alcoholic beverages including pairs of regular and plant-based alternatives (iced coffee/iced coffee with almond milk, fruit smoothie/fruit smoothie with soy milk and cow's milk/oat milk). Particular focus was directed to comparing product perceptions of consumers who never consumed these plant-based alternatives with those who did ($n = 249$ and $n = 274$), as a means for contextualising the barriers that hinder uptake among non-users. The data were collected via an online survey with a multi-response empirical strategy where the beverages were characterised using a large set of emotional, conceptual, situational, and attitudinal/behavioural variables. Fitting expectations, negative associations were dominant in the group of consumers who never consumed the plant-based beverage variants. However, these associations were product dependent and decreased in the order: oat milk, fruit smoothie with soy milk and iced coffee with almond milk. This pointed to a likely interplay of sensory properties, situational appropriateness and household routines. Food neophobia negatively influenced perceptions of less familiar products, including but not limited to plant-based beverages. While the research was limited to a small number of beverages and plant-based alternatives, it identified the important role that in-depth and product-specific investigations have in helping to uncover and overcome barriers to sustainable eating and drinking solutions.

1. Introduction

1.1. The need to transform food production and consumption

Current food systems, especially those in the West are major drivers of poor health and environmental degradation worldwide, and collective efforts to transform food production and consumption are needed (Willett et al., 2019).

Transition to a sustainable food system will not happen without changes to what we eat and drink. Specifically, a shift is required towards a more plant-based (PB) diet with lower intake of products of animal origin, and such a shift is generally regarded as a “win-win” scenario which also achieves positive outcomes for public health and the environment.

1.1.1. Plant-based beverages, a category in expansion

The increasing societal demands for sustainability is seen the increase in people identifying as vegan, vegetarian or flexitarian (Asche-mann-Witzel, Gantriis, Fraga, & Perez-Cueto, 2020), by technological innovations enabling new product development of PB foods and beverages (e.g., extraction of PB protein) (e.g., Loveday, 2019; Mune-kata et al., 2020), and by the rapidly expanding market for PB foods.

Focus in the present research was directed to beverages, specifically non-alcoholic beverages, which is a large and evolving category where PB variants increasingly are commercially available (Paul, Kumar, Kumar, & Sharma, 2020). Over the last two decades, the global consumption of non-dairy PB beverages, coming from legumes (e.g., soybeans), cereals (e.g., rice and oats) or nuts (e.g., almonds and hazelnuts) has increased considerably because of health and environmental concerns, lactose intolerance, and flexitarian consumption choices.

* Corresponding author.

E-mail address: sara.jaeger@plantandfood.co.nz (S.R. Jaeger).

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According to recent estimates the market growth rate for PB beverage alternatives is 15% (Euvepro, 2019; Munekata et al., 2020).

Comparatively less attention has been devoted in the literature to studying consumer demand and needs for PB beverages compared with solid foods. Since foods and beverages have very different sensory properties and roles in people's diets, it cannot be expected that consumer responses to PB meat alternatives readily generalise to PB beverages. Thus, by focusing on the beverage category, we add new knowledge, and contribute a broader understanding of the PB product space as a whole. This should contribute needed knowledge on barriers to uptake and how to overcome them.

1.2. Understanding plant-based product experience through a multi-response approach

1.2.1. Reduced consumer expectations and acceptability of plant-based products

Sensory properties of plant-based foods and beverages constitute a significant barrier to consumer acceptance. A recent review by Fiorentini, Kinchla, & Nolden (2020) on meat alternatives noted persistent challenges in dealing with undesirable off-flavours from the lipid oxidation of unsaturated fatty acids, and in recreating the unique texture, mouthfeel, and juiciness of traditional meat products.

Problems also plague PB milks, which can contain particle aggregates that are so large that they cause grainy or gritty mouthfeel sensations that reduce acceptability (McClements, 2020). Soy milk can possess "beany" and "painty" off-flavours originating from lipoxygenase activity (Mäkinen, Wanhalinna, Zannini, & Arendt, 2016; Chambers et al., 2006).

The situation is made worse for PB products that have a direct animal counterpart (e.g., milk, cheese, yoghurt, minced meat) since consumers have sensory expectations (appearance, smell, taste, texture) that are often unmet by the plant-based offerings (Aschemann-Witzel et al., 2019; Hoek et al., 2011). For instance, a comparison of the acceptance of lactose-free cow's milk and soy milk among American adults and children found that lactose-free cow's milk was clearly preferred over soy milk (Palacios et al., 2009; Palacios et al., 2010).

Negative experiences and unfavourable comparisons with animal counterparts may lower expectations towards these products among many consumers. This is the reason why, for instance, meat alternatives are often marketed with slogans such as "tastes like meat" to reduce unfamiliarity and form positive expectations (Fiorentini, Kinchla & Nolden, 2020). However, while many present-day PB beverages may have an improved sensory quality, as a product category these beverages may still carry a stigma because of early less appealing products in the market. For example, Haas, Schnepps, Pichler, & Meixner (2019) found that consumer expectations towards plant milks tended to be much lower than towards cow milk.

1.2.2. A multi-response approach to product research

The focus in past research on sensory acceptability of PB products, often relative to dairy counterparts, has been warranted. However, it is also insufficient considering that sensory acceptability is but one factor driving food choice and consumption decisions, and rarely a strong predictor of marketplace performance (e.g., Rosas-Nexticapa, Angulo, & O'Mahony, 2005). Accordingly, consumer scientists have advocated for the inclusion of a broader set of measures of product performance (Giacalone, 2018), and for the purposeful combination of different response types to better capture the inherent complexity of consumer experiences (Cardello et al., 2016; Jaeger et al., 2017; Jaeger et al., 2020). Below we briefly consider emotional associations, conceptualisations and situational appropriateness which are three main components of the present research.

Product-related emotional associations and conceptualisations Purchase decisions for food and beverage products are rarely driven exclusively by rational considerations such as price and health

information. They are instead often impulsive and driven by emotions connected to past consumption (e.g., Desmet & Schifferstein, 2008; Thomson & Coates, 2020), and this understanding has spurred interest in product-related emotional associations and conceptualisations (Meiselman, 2017; Thomson & Coates, 2020).

To the authors' knowledge, only one study has contributed to uncovering consumers' product-elicited emotional associations of PB beverages (McCarthy, Parker, Ameerally, Drake, & Drake, 2017), in which the authors did not find major differences between the emotion profiles for cow's milk and plant alternatives. However, responses were only elicited from product users, and these data are, therefore, not helpful in understanding barriers to uptake. Further, since the study only focused on fluid milk and its PB alternative, it is uncertain if the findings replicate in other plant-based beverages.

Product conceptualisations can include emotions and feelings, and conceptual profiling (e.g., classy, genuine, conservative, free-spirited, youthful) extends product characterisations compared to emotional associations alone. While applications have been modest relative to emotion research, conceptualisations are likely to be a rich source of product insight in the domain of PB products, since links exist between meat-masculinity and meatless-femininity (e.g., Mycek, 2018; Schöslér, de Boer, Boersema, Aiking, 2015), and social conventions regarding eating and drinking influence perceptions of non-meat eaters (e.g., Markowski & Roxburgh, 2019).

Situational appropriateness Consumption context and its role in orienting consumers' choices is of considerable importance (Schutz, 1994). Accordingly, there has been a steady stream of research focused on perceived situational appropriateness, with the end-goal of ensuring that new products not only have high acceptability, but also high appropriateness for the consumption contexts normally associated with that category. Increasingly, inclusion of appropriateness data is considered essential for full product characterisation (Cardello & Schutz, 1996; Jaeger & Porcherot, 2017).

Recent research on PB meat alternatives indicates that consumers tend to perceive meat products as more situationally appropriate than their PB alternatives (e.g., hamburger vs. vegetarian hamburger) in almost all situations (Elzerman, Keulemans, Sap & Luning, 2021), which may be related to the general phenomenon that less familiar foods and beverages tend to be rated as less appropriate (Giacalone & Jaeger, 2016). Although similar data on PB beverages have not yet been published, it is probable that low perceived situational appropriateness acts as a barrier to acceptance and uptake.

1.3. Food neophobia as a barrier to uptake of plant-based foods and beverages

Product features interact with person characteristics to define individual consumption choices and habits (e.g., Jaeger, Bava, Worch, Dawson, & Marshall, 2011), and for this reason the latter contribute to in-depth consumer-centric product research. Despite the prevalence of considering demographic and socio-economic variables (Symmank et al., 2017), we focus on food neophobia (FN), a stable personality trait which profoundly affects consumption behaviours and preferences (Pliner & Hobden, 1992). The fear of consuming unfamiliar foods can lead to decreased dietary variety and quality (e.g., Knaapila et al., 2015; Jaeger, Rasmussen, & Prescott, 2017).

Being novel and unfamiliar, research into acceptance and uptake of PB foods has frequently drawn on FN, hypothesising and finding that acceptability and consumption decreases with increasing FN (e.g., Siegrist & Hartmann, 2020; Bryant, Szejda, Parekh, Desphande, & Tse, 2019). That is, consumers of meat substitutes tend to be less neophobic (Apostolidis & McLeay, 2016; Elzermann et al., 2021). Similar findings have been reported for consumption of insects, which like PB meats are alternatives to traditional protein sources (e.g., Sogari, Bogueva, & Marinova, 2019; de Carvalho, Madureira, & Pintado, 2020).

In the case of PB beverages, based on their novelty and findings like

the above for PB meat, we expect to find a negative effect of FN such that higher consumption and positive perceptions exist among those who are less neophobic. Further, it is likely that the FN effect will be product specific, both within PB alternatives and in general. Soy milk, which has been available for many years may be more familiar than recent non-dairy alternatives such as sprouted pea milk. This would fit with past reports that the FN effect is highly product dependent (e.g., Barrena & Sánchez, 2013).

1.4. Research aim and contribution

The present research extends beyond the common focus on sensory acceptability and adopts a multi-response approach to jointly obtain emotional, conceptual, situational and attitudinal/behavioural (conative) evaluations of PB beverages. A focus on barriers to uptake is achieved through a two-fold strategy: comparison of PB beverages and their regular variants (sample pairs), and comparison of consumers who are product users and those that are non-users. The former is further enhanced by comparison with other beverages, seeking to provide a broader perspective and a measure of magnitude of effect. If differences between a PB beverage and regular variant are uncovered, how big are these differences relative to other types of beverages? With regard to the comparison of product non-users and users, barriers to uptake among non-users become contextualised through a comparison of product experience among users and offer insights that can guide initiatives to increase consumption.

The remainder of this paper is structured as follows: Full participant and empirical details are presented in Section 2, together with details of the data analytical strategy. The findings are presented in main sections relating to emotional, conceptual, situational and attitudinal/behavioural responses. The effects linked to FN are presented last, and are immediately followed by discussion and conclusions.

2. Materials and methods

2.1. Participants

The research was conducted online with consumers in the USA. Complete data were obtained from 603 consumers (18–65 years old, 50% female) with varying backgrounds (ethnic, socio-economic, political, etc.). Part 1 of Supplementary Materials has full details.

Participants were registered with an ISO accredited web panel provider (Lightspeed GMI Global). All participants were involved in household grocery shopping and free of major dietary restrictions and allergies (e.g., nut, lactose, gluten). To focus on main-stream consumers, vegans and vegetarians were not eligible for participation in the research.

The research was covered by a general approval for sensory and consumer research from the Human Ethics Committee at The New Zealand Institute for Plant and Food Research Limited (PFR). Participants gave voluntary consent and were assured that their responses would be kept confidential. As compensation, participants earned reward points and promotional offers.

2.2. Stimuli

Written stimuli were used deliberately as part of the effort to focus beyond sensory acceptability. Relative to tasted samples, they directed participants' attention to the non-sensorial features of the products. This facilitated achievement of the aims of the research.

An iterative process took place where candidate beverage names were initially developed by one author and revised following discussion with other authors and input from five experienced sensory and consumer research professionals from the USA. This resulted in a total of nine beverage names, of which six were paired samples that represented regular and PB variants of the same "base product": *Cow's milk*, *Oat milk*

(pair), *Fruit smoothie*, *Fruit smoothie with soy milk* (pair), *Iced coffee* and *Iced coffee with almond milk* (pair). Seeking category coverage, the PB variants included non-dairy alternatives from the three dominant marketplace variants - soy, almonds and oat (e.g., Sethi, Tyagi, & Anurag, 2016). The remaining three stimuli - *Still water*, *Kombucha*, *Energy drink* - were selected to obtain a broad coverage of the non-alcoholic product space, and were specifically chosen to span continua relating to familiarity, perceived healthfulness and functional benefits (e.g., Ali, Rehman, Babayan, Stapelton, & Joshi, 2015; Knapp & Sumner, 2019). The purpose was to understand if certain PB alternatives are more similar/different to other product offerings such that inspiration for strategies to reducing consumption barriers could be based hereupon. Finally, variation regarding emotional, conceptual and situational product characteristics was sought across the beverage stimuli (e.g., Ng, Chaya, Hort, 2013; Waehrens, Grønbeck, Olsen, & Byrne, 2018; Bhumiratana, Wolf, Chambers, & Adhikari, 2019; Samant & Seo, 2020).

2.3. Data collection

2.3.1. Product characterisation and consumption

The beverage names were presented sequentially and participants completed an extensive product characterisation task in four parts.

Emotional associations (Table 1a): A circumplex-inspired emotion question with 12 pairs of emotion words was used (Jaeger, Roigard, et al., 2021) (Part 2 of Supplementary Material). Prior to initiating stimuli evaluation, the circular structure of the questionnaire was described to participants, identifying the two underpinning dimensions - valence (pleasure to displeasure) and arousal (activation to deactivation) - and how each of the 12 domains blended these dimensions. Participants were instructed to think about [beverage name] and select one of the 12 word pairs in response to the question "how do you feel?"

Conceptual associations (Table 1b): A general lexicon of 30 words (Thomson, 2016) was implemented as a CATA (check-all-that-apply) question. Participants were instructed to think about [beverage name] and select all applicable words.

Situational appropriateness (Table 1c): Ten usage situations were selected to span a range of perceived situational appropriateness for the focal beverages. Participants were instructed to think about [beverage name] and rate each use situation on a 7-pt scale with end-point anchors 1='not at all appropriate' and 7='very appropriate'.

Attitude/behaviour (Table 1d): Responses to seven statements covered liking, familiarity, and purchase and usage intention. Participants were instructed to think about [beverage name] and rate each statement on a 7-pt Likert scale (1='disagree strongly'; 7='agree strongly').

Stated consumption frequency for the beverages was recorded subsequent to the product characterisations. Two questions were used. 'Have you at some point in the past consumed the following [beverage name]?' with responses obtained as 'yes', 'no' or 'don't know'. Only those who responded 'yes' were asked the follow-up question: 'How often, on average, have you during the past year consumed [beverage name]?' Responses were collected using the categories: 1='never in the past 12 months', 2='less than once every 6 months', 3='less than once a month', 4='1-3 times per month', 5='once a week', 6='2-4 times per week', 7='5-6 times per week', and 8='once a day or more'.

2.3.2. Food neophobia and background responses

Food neophobia (FN) was measured using six items from the scale by Pliner and Hobden (1992). These items were based on a scale refinement study by Ritchey et al. (2003) who identified them as an adequate subset for use in the USA. Statements were presented in randomised order across participants, with responses obtained on 7-pt Likert scales (1='disagree strongly' and 7='agree strongly'). Summed scores were calculated (Cronbach's alpha = 0.80) and spanned the full theoretical range from 6 to 42. To allow easier comparison with past studies using all ten items from Pliner and Hobden (1992), the summed scores were

Table 1

Emotional, conceptual, situational and behavioural responses (alphabetical order) obtained for nine beverage names.

Response	Variables
A. Emotional	Active/alert
	Blue/uninspired
	Dull/bored
	Energetic/excited
	Enthusiastic/inspired
	Happy/satisfied
	Jittery/nervous
	Passive/quiet
	Relaxed/calm
	Secure/at ease
	Tense/bothered
	Unhappy/dissatisfied
B. Conceptual	Adventurous
	Aggressive
	Arrogant
	Boring
	Carefree
	Cheap
	Classy
	Comforting
	Confident
	Easygoing
	Energetic
	Feminine
	Friendly
	Fun
	Genuine
	Happy
	Inspiring
	Irritating
	Masculine
	Modern
	Powerful
	Pretentious
	Sensual
	Serious
	Simple
	Sophisticated
	Traditional
	Trustworthy
	Unique
	Youthful
C. Situational	As part of breakfast
	At a café
	For children
	In cooking or baking
	In the evening
	To accompany a sit-down meal
	To boost my health
	To drink on the go
	To quench my thirst
	To replace a light meal
D. Attitudinal	I am familiar with this beverage
	I cannot imagine ever wanting to drink this beverage
	I expect to like this beverage
	I would drink this beverage if it was offered to me
	I would like to consume this beverage on a regular basis
	I would serve this beverage to friends and family
	If it was for sale, I'd buy this beverage

scaled by a 10/6 multiplier.

Other background questions included gender, age, ethnicity, educational attainment, income, household size, household composition, place of living and political party affiliation. FN and background measures were obtained subsequent to the product characterisations.

2.3.3. Implementation

During data collection, the presentation order of beverage names was always randomised across participants. Within a participant, the product responses were always obtained in the order given in [Section 2.3.1](#). All CATA terms, usage situations, and Likert statements were

presented in randomised order across participants.

Participants completed the survey from a location of their choosing, using a laptop or desktop computer. The survey also covered other topics on food-related consumer behaviour, but these were not relevant to the present research and are not discussed further. The questions pertaining to the beverage stimuli were placed at the start of survey. The median time to complete the tasks related to this research was 14 min.

2.4. Data analysis

All analyses were performed in XLSTAT v 2020.5.1 using a 5% significance level.

2.4.1. Defining groups of consumers who consume/do not consume PB variants

Two consumer groups were created on the basis of past consumption of the PB beverage variants in the product set: *Oat milk*, *Fruit smoothie with soy milk* and *Iced coffee with almond milk*. A total of 274 participants were classified in the “not PB” group because they stated that they never in the past had consumed either of the three PB products. Another 249 participants were classified into the “PB use” group because they had either: i) consumed at some time in the past any 2 of the 3 PB variants, or consumed only one of them, but was doing so at least 1–3 times monthly. All other participants were excluded, making $n = 523$ (87%) the effective sample size for the PB group comparisons. Practical considerations influenced these group definitions, seeking to have “large” groups of similar size.

2.4.2. Analysis of product responses within PB consumer groups

The same analyses were performed within each of the two PB consumer groups (“not PB” and “PB use”), focusing on sample similarities and differences with regard to the different sets of response variables (emotional, conceptual, situational, attitudinal and behavioural) ([Table 1](#)).

For binary responses (emotional and conceptual), Cochran's Q tests were used to identify significant differences among the nine beverage names for each of the 12 emotion word pairs and each of the 30 conceptual terms. Where significant differences existed, pairwise comparisons of differences in frequency of word use were performed using Sheskin's procedure of minimum required differences ([Sheskin, 2011](#)). Correspondence Analysis (CA) based on chi-square distances was then performed on the frequency count table (products \times words), retaining two-dimensional solutions. Confidence ellipses (95%) around stimuli positions were obtained using a bootstrapping approach.

For rated responses (situational, attitudinal, behavioural), analysis of variance was performed using beverage stimuli as fixed factor and consumers as random factor. Where significant differences existed, pairwise comparisons of mean statement values were performed using Tukey's HSD test. Principal Components Analysis (PCA) based on the correlation matrix was performed on the table of mean values (products \times attributes), retaining two-dimensional solutions. Confidence ellipses (95%) around stimuli positions were obtained using a bootstrapping approach.

2.4.3. Effect of FN on consumption frequency

Commensurate with the paper's focus on barriers to consumption of PB beverages, the effect of FN was explored specifically in relation to stated consumption frequency. The popular extreme groups approach was eschewed since it is not regarded as best practice when a variable is naturally continuous ([Preacher, Rucker, MacCallum, & Nicewander, 2005](#)), which empirical evidence shows FN to be (e.g., [Bryant, Szejda, Parekh, Desphande, & Tse, 2019](#); [Jaeger, Rasmussen, & Prescott, 2017](#); [Kozioł-Kozakowska, Piórecka, & Schlegel-Zawadzka, 2018](#)) (Part 3 of [Supplementary Material](#)). Instead, the effect of FN was captured through linear regression analyses where responses from all 603 participants were included without distinguishing between PB group membership.

To reduce noise in the data from individual data points (i.e., consumers), the analyses were performed on means of consumption frequency calculated for each value of FN in the 6 to 42 range (i.e., FNS = 10, FNS = 11, FNS = 12, etc). In the case of the three product pairs, a second analysis was performed where product variant (regular or plant-based) was treated as a qualitative factor, allowing the joint estimation with FN (ANCOVA with 2-way interaction).

3. Results

3.1. Consumption frequency for the beverages

The two consumer groups were defined on the basis of criteria for past consumption of the three PB beverages (*Oat milk*, *Fruit smoothie with soy milk* and *Iced coffee with almond milk*), and this difference showed clearly in Table 2, as did the fact that not everyone in the “PB use” group had consumed all three beverages in the past year. *Oat milk* was most likely to not have been consumed (26.1%) while *Iced coffee with almond milk* was least likely to not have been consumed (12.4%).

Notably, however, differences between the two consumer groups extended beyond consumption of the PB beverages. The “PB use” and “not PB” groups reported similar high average consumption frequencies for *Cow's milk* and *Still water* (weekly or more; Table 2), but all of the other beverages were much less frequently consumed by participants in the “not PB” group (less than once every 6 months; Table 2). Visually this was captured in Fig. 1, which shows the results following PCA performed on the correlation matrix of the individual level consumption frequency data. The separation of *Cow's milk* and *Still water* from the other beverages was seen in Fig. 1a, and in Fig. 1b, by identifying individuals as members of either the “PB use” or “not PB” group the different beverage consumption patterns were highlighted. In this regard, it was also observed that the “not PB” group was more homogeneous than the “PB use” according to the spatial separation of participants along dimension 1.

3.2. Emotional responses to the beverages

In both consumer groups, the nine beverage stimuli were significantly differentiated on all pairs of emotion words (Table 3a), with one

Table 2

Stated beverage consumption behaviour^(1,2) for the groups “PB use” (n = 249) and “not PB” (n = 274).

Beverage name	“PB use” Have not consumed	“not PB” Have not consumed	“PB use” Consumption frequency [#]	“not PB” Consumption frequency [#]
	%	%	Mean*	Mean**
Cow's milk	10.0	9.9	5.1 ^b	4.7 ^b
Energy drink	22.5	67.5	3.5 ^{de}	1.0 ^d
Fruit smoothie	6.4	33.6	4.5 ^{bc}	1.7 ^c
Fruit smoothie w/ soy milk	22.5	100.0	3.3 ^e	0.0 ^e
Iced coffee	8.4	54.4	4.6 ^{bc}	1.6 ^c
Iced coffee w/ almond milk	12.4	100.0	4.1 ^{cd}	0.0 ^e
Kombucha	32.5	88.0	2.8 ^e	0.3 ^e
Oat milk	26.1	100.0	3.2 ^e	0.0 ^e
Still water	8.8	14.2	6.1 ^a	5.8 ^a

Notes. PB = plant-based. 1) “Have you at some point in the past consumed the following beverage?” Yes, No or Don't know. 2) If “yes” in (1), then “How often, on average, have you during the past year consumed this beverage?” Responses were collected using 7 categories: 1=‘never in the past 12 months’, 2=‘less than once every 6 months’, 3=‘less than once a month’, 4=‘1-3 times per month’, 5=‘once a week’, 6=‘2-4 times per week’, 7=‘5-6 times per week’, and 8=‘once a day or more’. If “no” in (1), then past consumption frequency was coded as ‘0.’[#]) For consumption frequency, significant differences between beverages were determined using Tukey's HSD. Within consumer groups, beverages that share a letter are not different at the 5% level of significance. *) Std. error = 0.140 for all beverages; **) Std. error = 0.133 for all beverages.

exception for ‘blue/uninspired’ in the “PB use” group (p = 0.11; Part 4 of Supplementary Material). On average, the percentage of significant pairwise sample comparisons were higher among the non-PB users (35.2% vs. 20.6%) (Table 3a), and this also held for the three product pairs (*Cow's milk*, *Oat milk* (pair), *Fruit smoothie*, *Fruit smoothie with soy milk* (pair), *Iced coffee* and *Iced coffee with almond milk* (pair)), where only a single difference was found in the “PB use” group, compared with nine differences in the “not PB” group across the three product pairs. Table 4 summarises these results (with full details in Part 4 of Supplementary Material), presenting the directional difference in citation frequency for the PB variant within a product pair when compared with the regular variant. The PB variants were always perceived more poorly, and notably this extended to *Iced coffee with almond milk* in the “PB use” group. This beverage was less frequently associated with ‘active/alert’ than *Iced coffee*, potentially suggesting that the use of almond milk in coffee diminished the expected energy boost.

The biplots of the first two dimensions following Correspondence Analysis showed that the two consumer groups perceived some of the nine beverages similarly, and others differently. In both groups, *Energy drink* was separated from *Cow's milk* and *Still water* on the first dimension, with a strong association between *Energy drink* and ‘jittery/nervous’ (Fig. 2a – “PB use” group; Fig. 2b – “not PB” group). In the “not PB” group, *Cow's milk* and *Still water* was located close to *Fruit smoothie* and this product triad was foremost associated with positive emotions. *Iced coffee* was positioned closest to *Energy drink* and associated with ‘energetic/excited’ and ‘active/alert.’ The second dimension separated these five highly familiar beverages from those that were generally less well known – *Kombucha* and the three PB variants. Deactivated emotions were strongly associated with *Fruit smoothie with soy milk*, while more negative emotions dominated for the three PB variants that varied in degree of activation (‘blue/uninspired’ for *Oat milk* and ‘tense/bothered’ for *Iced Coffee with almond milk*).

Notable differences in product associations in the “PB use” group were evident (Fig. 2a vs. Fig. 2b). Associations linked to emotional deactivation were less evident in the case of *Fruit smoothie with soy milk* and *Iced coffee with almond milk*, while in the case of *Oat milk* the associations remained deactivated but were less negative. On average, *Kombucha* was negatively perceived in both consumer groups, but differently associated with either high emotional activation (‘tense/bothered’) among PB users or low emotional activation (‘dull/bored’) among non-PB users. The lesser degree of sample separation found in the univariate analyses for the “PB use” group compared with the “not PB” group was also seen in the CA sample spaces where the 95% confidence intervals around sample positions were more overlapping (Part 5 of Supplementary Material).

3.3. Conceptual responses to the beverages

For conceptual variables (Table 1b), the pattern of results resembled that found in the emotional responses with regard to larger magnitude of beverage sample differentiation in the “not PB” group (Table 3b; Part 6 of Supplementary Material). This further supported the insight that the beverage samples were perceived as more different to each other by those participants who never consumed these PB beverages than by those who did. Further to more significant pairwise comparisons (35.1% vs. 22.5%), a visual comparison of the sample spaces spanned by the first two dimensions following CA again highlighted that some beverages were differently perceived by the two consumer groups while others were not (*Energy drink*, *Still water*, *Cow's milk*) (Fig. 3). It was particularly seen that the 95% confidence ellipses around *Fruit smoothie with soy milk* and *Iced coffee with almond milk* were overlapping with their respective non-PB counterparts (*Fruit smoothie* and *Iced coffee*) in the case of the “PB use” group. The opposite was the case in the “not PB” group where the confidence ellipses were non-overlapping (Part 7 of Supplementary Material). The major similarities and differences in conceptual associations between the two consumer groups were seen in Fig. 3 and include

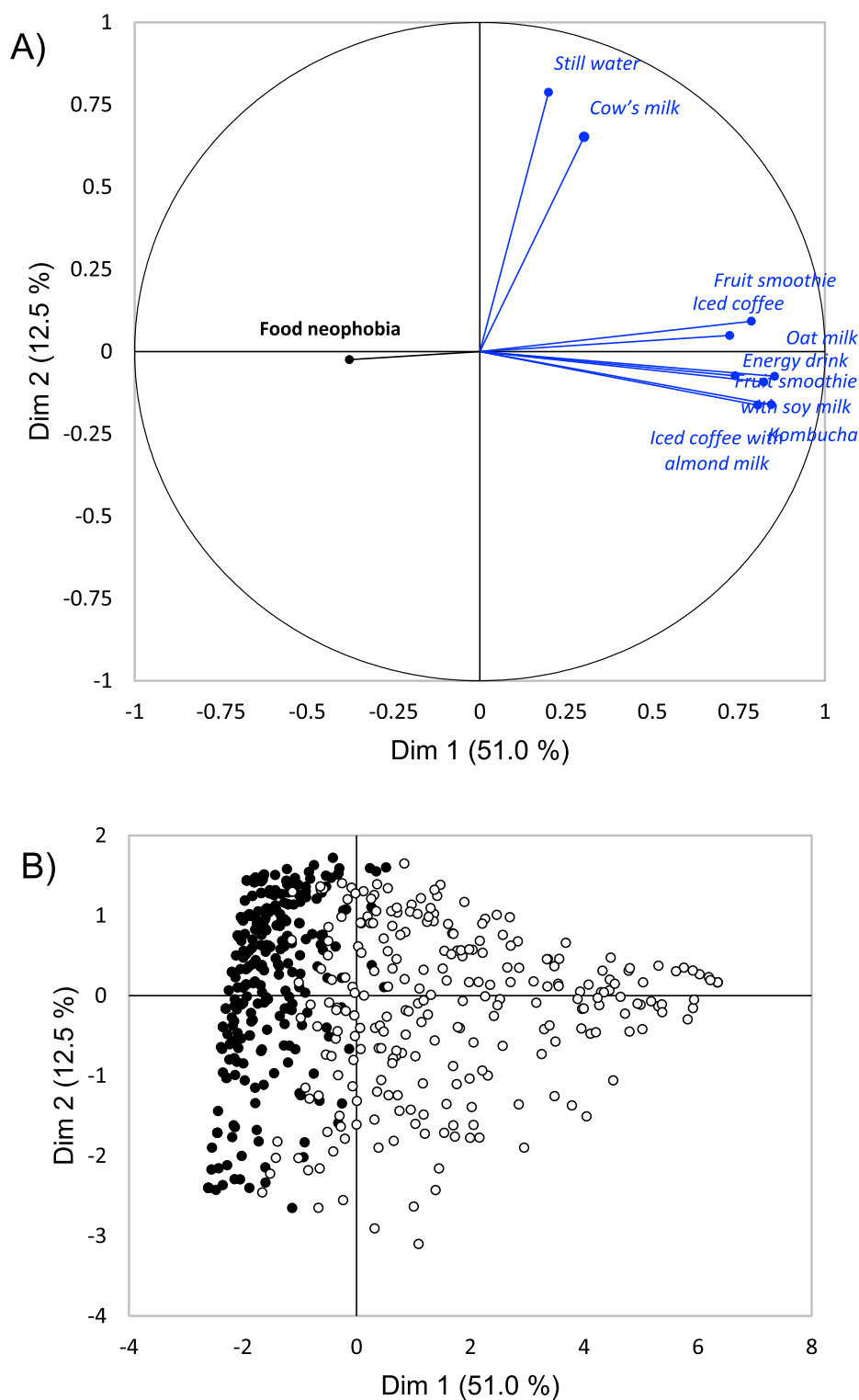


Fig. 1. Two-dimensional spaces (Dim. 1 vs. Dim. 2) following Principal Components Analysis of responses for stated consumption frequency. A) Variables, showing the beverage names (italic font, blue) and food neophobia (supplementary variable; bold font, black) and B) Observations, showing consumers in the “PB use” group (n = 249; unfilled circles) and consumers in the “not PB” group (n = 274, filled circles). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

‘traditional’ applying to *Still water* and *Cow’s milk* for “PB use” and “not PB” participants alike, while ‘boring’ only applied to these two beverages in the “PB use” group. In the “not PB group” this term was more strongly associated with the three PB samples and *Kombucha*. For *Energy drink*, ‘arrogant’ applied in the “PB use” group, while in the “not PB” group this term was also more closely associated with the three PB samples and *Kombucha*. Both group of consumers, however, perceived the PB beverages (and *Kombucha*) as more feminine than other samples (Fig. 3).

With regard to the direct comparison of the regular and PB variant in the three sample pairs, Table 4 highlighted that the differential perception was product specific. The largest number of pairwise differences were found for the pair of milk samples (*Cow’s milk* vs. *Oat milk*) with the PB variant being perceived as less ‘carefree,’ ‘comforting,’ ‘confident,’ ‘easygoing,’ ‘friendly,’ ‘happy,’ ‘genuine,’ ‘simple,’ ‘traditional,’ and ‘trustworthy;’ and more ‘boring,’ ‘irritating,’ ‘modern,’ ‘pretentious’ and ‘unique.’ For the pair of fruit smoothie samples (*Fruit smoothie* vs. *Fruit smoothie with soy milk*), there were 10 differences

Table 3

Summary of univariate and multivariate analyses for nine beverage samples. Shown for emotional, conceptual, situational, attitudinal/behavioural variables (as per Table 1, Parts A to D), presenting results (%) for the “PB use” group (n = 249) and the “not PB” group (n = 274) in separate columns. The 5% level was used for significance.

Response variable and test summary (in %)	Group “PB use”	Group “not PB”
A. Emotional		
Variables with significant sample discrimination	91.7	100.0
Significant pairwise sample comparisons	20.6	35.2
Dim 1 (inertia)	48.7	55.8
Dim 2 (inertia)	26.6	28.5
B. Conceptual		
Variables with significant sample discrimination	93.3	96.7
Significant pairwise sample comparisons	22.5	35.1
Dim 1 (inertia)	46.6	54.2
Dim 2 (inertia)	27.7	24.2
C. Situational		
Variables with significant sample discrimination	100.0	100.0
Significant pairwise sample comparisons	55.8	76.1
Dim 1 (variance)	63.3	79.3
Dim 2 (variance)	18.8	9.8
D. Attitudinal/behavioural		
Variables with significant sample discrimination	100.0	100.0
Significant pairwise sample comparisons	48.8	75.8
Dim 1 (variance)	94.3	96.7
Dim 2 (variance)	4.1	2.5

Note. PB = plant-based.

compared with 15 above, and while many of these were overlapping, differences also existed for ‘fun’ and ‘youthful’ (which *Fruit smoothie with soy milk* was less), possibly reflecting that smoothies are modern and trendy (e.g., McCartney, Rattray, Desbrow, Khalesi, & Irwin, 2018). Fewest differences were found for the pair of iced coffee samples, where *Iced coffee with almond milk* was less ‘energetic,’ ‘simple’ and ‘traditional.’ It was notable also that the three terms where differences existed were less associated with negative valence than seen for *Cow’s milk* vs. *Oat milk* and *Fruit smoothie* vs. *Fruit smoothie with soy milk*.

3.4. Situational use responses to the beverages

Compared with the emotional and conceptual responses, the situational use data (Table 1c) was associated with greater sample discrimination which extended to all variables and a greater percentage of pairwise sample comparisons (Table 3c). In the “not PB” group, 76.1% were significant, compared with 55.8% for the “PB use” group. Again, the two consumer groups were largely in agreement on their perceptions of *Energy Drink*, *Kombucha*, *Still water* and *Cow’s milk*, where the former two beverages were considered as less/least appropriate for the investigated uses, and the two latter beverages were considered as more/most appropriate for the investigated uses (Part 8 of Supplementary Material). This was seen clearly in the two-dimensional spaces following PCA (Fig. 4), and these plots also revealed the more unidimensional product separation in the “not PB” group compared with the “PB use” group. Relative to the “PB use” group, PC1 accounted for more variance and PC2 for less variance in the “not PB” group. Generally speaking, in the two-dimensional space based on the “PB use” group (Fig. 4a), the samples were more clearly differentiated according to appropriateness of use, whereas they seemed to be more strongly discriminated on affective evaluations in the “not PB” group (Fig. 4b). For example, *Cow’s milk* and *Oat milk* were similarly perceived in the “PB use” group as most suitable ‘for children’ and ‘in cooking/baking,’ and the 95% confidence ellipses around these two sample positions overlapped (Part 9 of Supplementary Material). This was not the case in the “not PB” group, where *Oat milk*

Table 4

Comparison of product perceptions for three sets of paired beverage samples, showing the comparison of the plant-based (PB) variant relative to the regular variant. Significant differences ($p < 0.05$) shown, in order, for emotional, conceptual, situational, attitudinal and behavioural variables (as per Table 1, Parts A to D), presenting results for the “PB use” group (n = 249) and the “not PB” group (n = 274) in separate columns. Asterisks are used to indicate similar results in the two PB groups.

Comparison	Group “PB use”	Group “not PB”
Relative to <i>Cow’s milk</i> , <i>Oat milk</i> is ...		
Less	Cheap Traditional* For children* For cooking/baking* Familiarity*	Happy/satisfied Secure/at ease Carefree Comforting Confident Easygoing Friendly Happy Genuine Simple Traditional* Trustworthy For breakfast At a café For children* For cooking/baking* For evening With sit-down meal To boost health To drink on the go To quench thirst To replace light meal Familiarity* Expected liking Consume if offered Consume regularly Serve to friends and family Buy if for sale Blue/uninspired Dull/bored Unhappy/dissatisfied Boring Irritating Modern* Pretentious Unique* Not wanting to drink
More	Modern* Unique* Youthful	
Relative to <i>Fruit smoothie</i> , <i>Fruit smoothie with soy milk</i> is...		
Less	Friendly* Fun* Happy* Expected liking* Serve to friends and family*	Enthusiastic/inspired Energetic/excited Happy/satisfied Comforting Confident Easygoing Friendly* Happy* Fun* Youthful For breakfast At a café For children For evening With sit-down meal To boost health To drink on the go To quench thirst To replace light meal Familiarity Expected liking* Consume if offered Consume regularly Serve to friends and family* Buy if for sale Blue/uninspired Unhappy/dissatisfied Boring Irritating
More	Modern	

(continued on next page)

Table 4 (continued)

Comparison	Group “PB use”	Group “not PB”
Relative to <i>Iced coffee</i> , <i>Iced coffee with almond milk</i> is... Less	Active/alert	Pretentious
		Not wanting to drink
		Energetic/excited
		Simple
		Traditional
		Energetic
		To drink on the go
		Familiarity
		Expected liking
		Consume if offered
		Consume regularly
		Serve to friends and family
		Buy if for sale
More [#]		

Note. For the comparison between the two iced coffee stimuli, there were no significant differences in the direction “more.”

was regarded as less appropriate for these two uses, and the 95% confidence ellipses were not overlapped (Part 9 of [Supplementary Material](#)). While there was agreement in both consumer groups that iced coffee – with or without almond milk – was most suitable to ‘drink on the go’ or ‘at a café,’ the overall level of perceived appropriateness was notably lower among “not PB” users. In the case of ‘drink on the go,’ both iced coffee beverages were highly appropriate (>6 of 7) in the minds of “PB use” participants, while the average ratings were much lower in the “not PB” group, and more so for *Iced coffee with almond milk* (4.6 and 4.0 of 7, respectively). For other beverages and use situations, the two consumer groups were similar (*Cow’s milk* and ‘for children’: 6.1/6.1 and *Still water* and ‘to quench my thirst’: 6.3/6.1) (Part 8 of [Supplementary Material](#)).

The summary of the comparisons of the regular/PB beverage variants (Table 4) crystallised the above observations. In the case of *Oat milk* vs. *Cow’s milk*, the former was less appropriate in all ten use situations, and this extended to the direct comparison of *Fruit smoothie* and *Fruit smoothie with soy milk* (with one exception: this pair of beverages were not perceived as differently appropriate for ‘in cooking or baking’). The product-specific effect observed for the emotional and conceptual responses extended to situational uses, and there was only one use situation where *Iced coffee* and *Iced coffee with almond milk* were perceived as different – ‘to drink on the go.’

3.5. Attitudinal and behavioural responses to the beverages

In the case of the attitudinal and behavioural variables (Table 1d), the sample discrimination remained much greater in the “not PB” group than the “PB use” group (Table 3d, Part 10 of [Supplementary Material](#)) with a further increased unidimensional sample separation following PCA (Fig. 5). The results for this set of response variables were, thus, in line with those pertaining to emotional, conceptual and situational use variables.

In the “not PB” group, high scores (>5 of 7) were only found for *Cow’s milk*, *Fruit smoothie* and *Still water*, and for the other beverages familiarity, expected liking, consumption likelihood, purchase likelihood were significantly lower. Therefore, it was not only the PB beverage variants that were negatively perceived, but also *Energy drink* and *Kombucha* (Fig. 5, Part 10 of [Supplementary Material](#)). In the “PB use” group, *Energy drink* and *Kombucha* retained their lower scores relative to *Still water*, but the space spanned by the first two dimensions following PCA showed that these participants, on average, differentiated much less between the two fruit smoothie variants and between the two iced coffee variants (Part 11 of [Supplementary Material](#)). Interesting, also, was the observation that *Cow’s milk* was positioned in an intermediate position along dimension 1 in the “PB use” group. Thus, this highly familiar beverage was less positively regarded in the “PB use” group. Since participants with lactose intolerance were not eligible to

participate in the study, this differential product perception was unlikely to be due to dietary restrictions.

Unsurprisingly, in light of the above, the direct comparison of the three pairs of regular and PB beverage variants revealed significant differences in all possible comparisons but one (*Iced coffee* vs. *Iced coffee with almond milk* for ‘I cannot imagine ever wanting to drink this beverage’ (Table 4).

3.6. The role of food neophobia

To achieve the final component of the research, the role of FN was explored by examining the linkage with frequency of beverage consumption. FN was first used as a supplementary variable in the PCA of these data, and found to be negatively correlated with consumption frequency for all beverages except *Cow’s milk* and *Still water* (Fig. 1a). Decreased consumption frequency with increased FN fitted with the higher average FN score in the “not PB” group than the “PB use” group (30 vs. 40; $p < 0.0001$) (converted to 10–70 FN scale values).

The linear regression analyses corroborated this result. The first part of Fig. 6 shows the results for the three product pairs, with the regression lines for each variant shown in the same plot to highlight similarities and differences in the effect of FN (regular product variant as blue circles and plant-based product variant as red circles). The effect of FN and product variant were always significant ($p < 0.01$), and the regular variant was always more frequently consumed (Fig. 6a, b and c). However, it was only for the analysis involving *Cow’s milk* and *Oat milk* that the interaction effect was significant, seen clearly by the non-parallel regression lines in Fig. 6c. This result confirmed the product specific nature of the negative effect of FN on consumption frequency. More importantly, however, the fact that increasing FN was significantly decreased frequency of consumption for *Fruit smoothie*, *Iced coffee*, *Energy drink*, *Kombucha* and *Still water* (latter to a much smaller extent, Fig. 6f) indicated that being PB was not the primary factor underpinning low/no consumption among neophobic individuals.

4. Discussion

4.1. Barriers to consumption of plant-based beverages

Situated within the context of global efforts towards healthy and sustainable dietary habits, the present research focused on understanding barriers to consumption of PB beverages. Guided by extant literature (Cardello et al., 2016; Jaeger et al., 2017, 2020), the present research was built on the premise that a multi-response research strategy (jointly considering emotional, conceptual, situational and attitudinal/behavioural) would lead to a more nuanced understanding of consumers’ product perceptions and experiences with PB beverages. Table 3 contained the key supporting evidence in line with this expectation with further support arising from Figs. 2 to 5 and Parts 4 to 11 of [Supplementary Material](#).

Previous research (e.g., Haas, Schnepps, Pichler, & Meixner, 2019) indicated that consumers’ views on PB beverages are highly dependent on familiarity and consumption frequency. This, together with a focus on understanding barriers to uptake, motivated the systematic comparison of users vs. non-users. In line with expectations, differences between the “PB use” and “not PB” groups were uncovered for all response variables considered in the study. Specifically, among consumers in the “not PB” group there were, on average, significant barriers to consumption, which spanned all investigated aspects of product experience – emotional, conceptual, situational and attitudinal/behavioural. The process of overcoming barriers to consumption therefore appears challenging as resistance is multi-layered and likely harder to break through than by simply reformulating the products to improve their sensory acceptability.

The PB product variants were generally perceived more poorly than their regular counterparts, although the magnitude of the differences

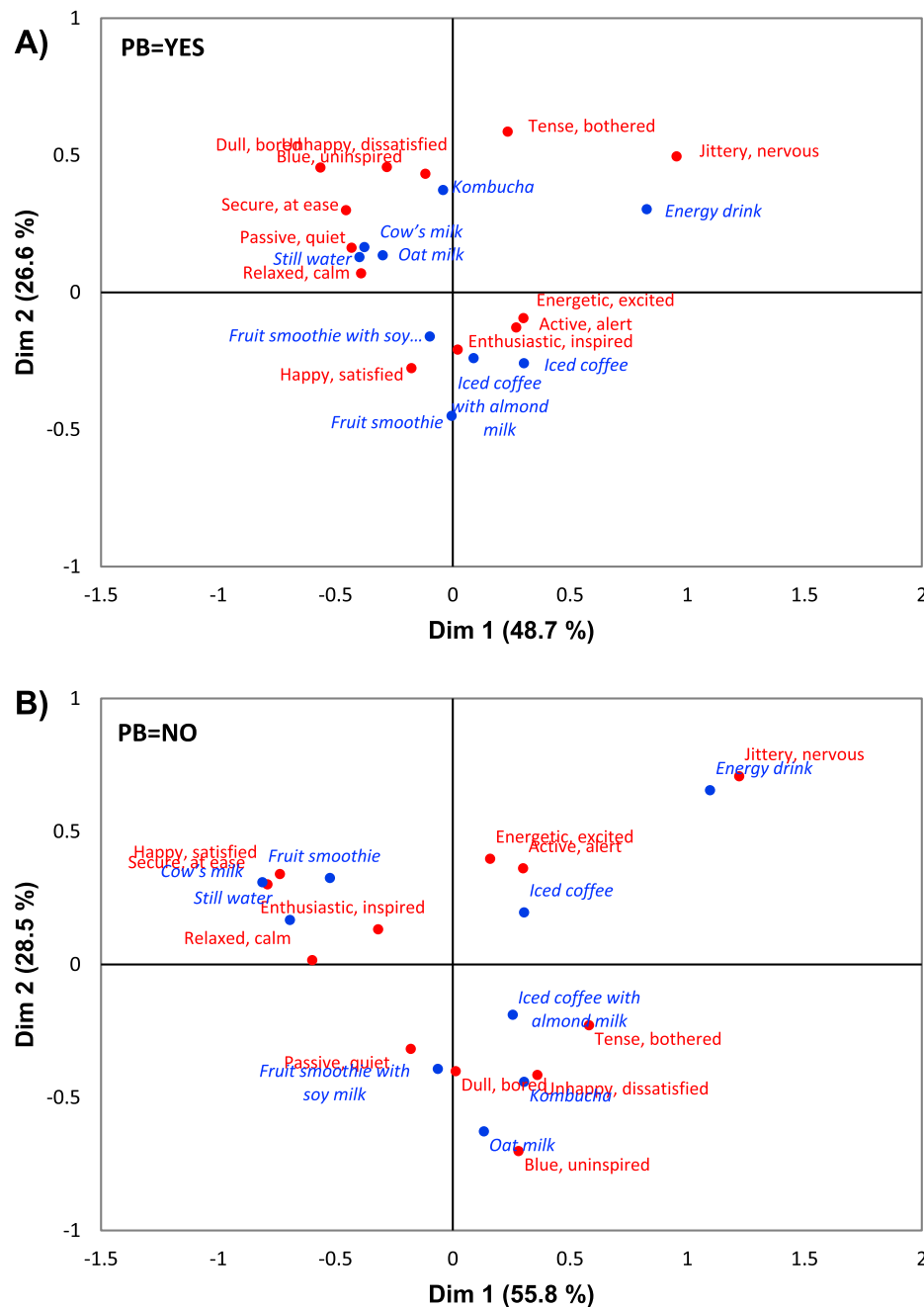


Fig. 2. Two-dimensional spaces (Dim. 1 vs. Dim. 2) following Correspondence Analysis of emotional responses. The beverage names (italic font, blue) and emotional word pairs (regular font, red) are shown together in a bi-plot. A) “PB use” consumer group (n = 249) and B) “not PB” consumer group (n = 274). Refer to Table 1a for the full list of variables. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

tended to be product specific, indicating that the two consumers groups perceived some of the beverages more similarly than others. As reviewed in the introduction, consumers’ emotional associations with PB beverages has received no attention in the literature but for one study on milk (McCarthy, Parker, Ameerally, Drake, & Drake, 2017), in which no major differences were found between cow’s milk and plant milk. Although the present research did not directly compare cow’s milk and plant milk, the results for the studied product pairs suggest that consumers’ emotional associations to PB beverages and their dairy counterparts do exist, and that PB variants are foremost associated with negative emotions, notably also (albeit less so) in the “PB use” group. The reason for this is not entirely clear but it may be a reflection that, although the popularity of these products is increasing, the category still carries the stigma of less appealing early products (Mäkinen,

Wanhalinna, Zannini, & Arendt, 2016). For example, Haas, Schnepps, Pichler, and Meixner (2019), in a study with Austrian consumers found that, cow’s milk generally tends to have a much better product image than plant milk, including being perceived as tastier, healthier and more natural.

Results pertaining to the conceptual evaluations tended to follow closely those of emotional responses in that PB beverage variants tended to be associated with more negative conceptualisations than their counterparts. Interestingly, PB variants were perceived by both consumer groups as more ‘feminine.’ This mirrors extant research on meat products showing a link between meat-masculinity and meatless-femininity (e.g., Mycek, 2018; Schösler, de Boer, Boersema, Aiking, 2015), and indicates that this link extends to beverages.

Product discrimination was greatest in the situational use

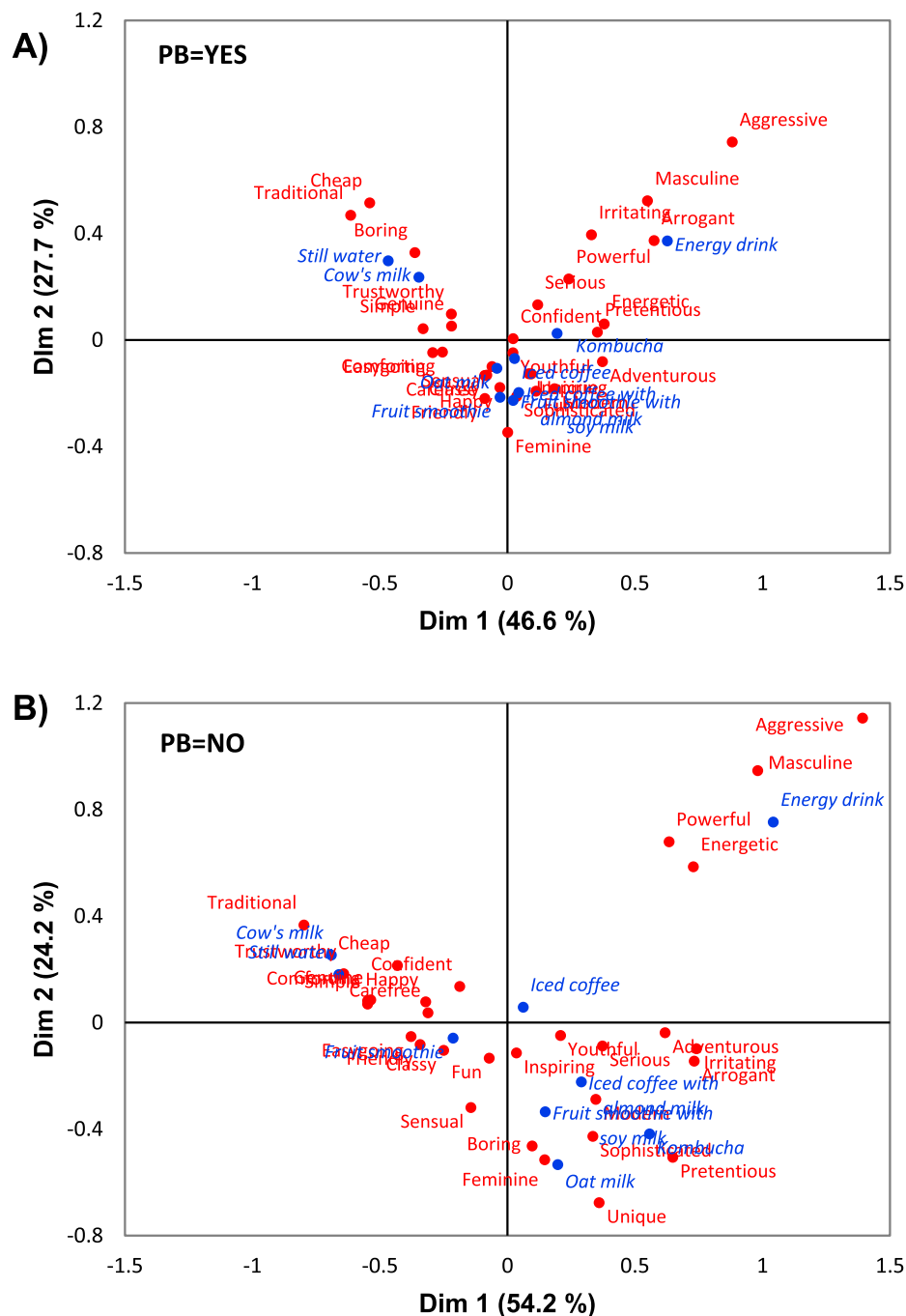


Fig. 3. Two-dimensional spaces (Dim. 1 vs. Dim. 2) following Correspondence Analysis of conceptual responses. The beverage names (italic font, blue) and conceptual words (regular font, red) are shown together in a bi-plot. A) “PB use” consumer group (n = 249) and B) “not PB” consumer group (n = 274). Refer to [Table 1b](#) for the full list of variables. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

evaluations, and the overall level of perceived appropriateness was notably lower among “not PB” users for almost all products. This seems to reflect the known association of familiarity with appropriateness (Giacalone & Jaeger, 2016), suggesting that a barrier to uptake may consist in non-users having issues envisaging how to incorporate PB beverages in their existing dietary habits. This interpretation is supported by the concurrent finding that the two consumer groups were found to largely agree on appropriate use for the two most familiar products (*Still water* and *Cow’s milk*). The finding that perceived appropriateness of PB beverages was higher in the “PB use” group also seems consistent with recent findings indicating that flexitarian and vegetarian consumers are much more willing to substitute from dairy

milk to PB beverages across all consumption uses (Wolf, Malone, & McFadden, 2020).

Finally, results for the attitudinal and behavioural variables were, generally, in line with those pertaining to the previous set of variables and show that expected liking, consumption likelihood, and purchase likelihood were lower in the “not PB” group than in the “PB use” group for all beverages except three - *Cow’s milk*, *Fruit smoothie* and *Still water*.

Although the “not PB” group generally showed greater product discrimination than the “PB use” group, it should be noted that consumer heterogeneity among current users also existed, particularly with respect to the frequency of consumption of specific PB beverages. Hence,

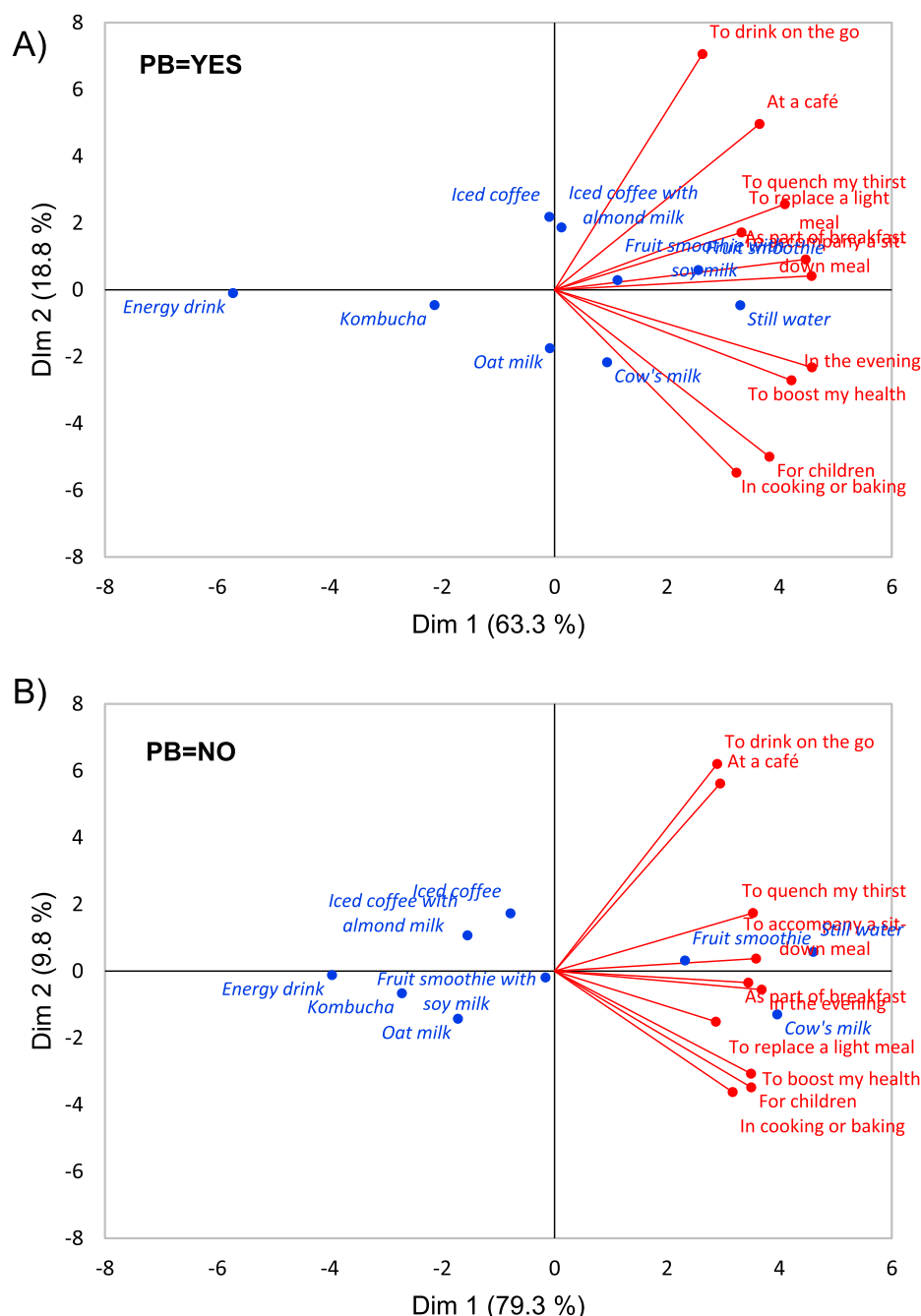


Fig. 4. Two-dimensional spaces (Dim. 1 vs. Dim. 2) following Principal Components Analysis of situational appropriateness responses. The beverage names (italic font, blue) and situational uses (regular font, red) are shown together in a bi-plot. A) “PB use” consumer group ($n = 249$) and B) “not PB” consumer group ($n = 274$). Refer to Table 1c for the full list of variables. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

a further lens could be applied to the use/not use classification to allow for a more detailed classification, for example, infrequent users to understand their path toward uptake of PB beverages. Fig. 1b supports this by showing the significant heterogeneity within the “PB use” group and suggesting that increasing consumption among infrequent users may be just as relevant a target as achieving uptake among non-users.

4.2. Food neophobia as a barrier to consumption

We expected and found that FN would act as a barrier to consumption (Fig. 1, Fig. 6), and this result extends other research into resistance to PB foods (e.g., De Koning et al., 2020). It also fits with past findings

for functional beverages where reluctance to consume among neophobic individuals has been reported (e.g., Barrera & Sánchez, 2013; Stratton, Vella, Sheeshka, & Duncan, 2015). The demographic profiles of the “PB use” and “not PB” groups (Part 1 of Supplementary Material) also fitted expectations regarding higher FN in the latter, since previous studies have found that people with higher levels of neophobia are generally older, less educated, less likely to work, earning less and living in households with fewer people (Meiselman, King, & Gillette, 2010).

Among consumers with neophobic tendencies, strategies to overcoming this added barrier to consumption will likely be similar to the strategies that are known from other FN research and primarily centre on exposure to increase familiarity (e.g., Yeomans, 2006). Familiar

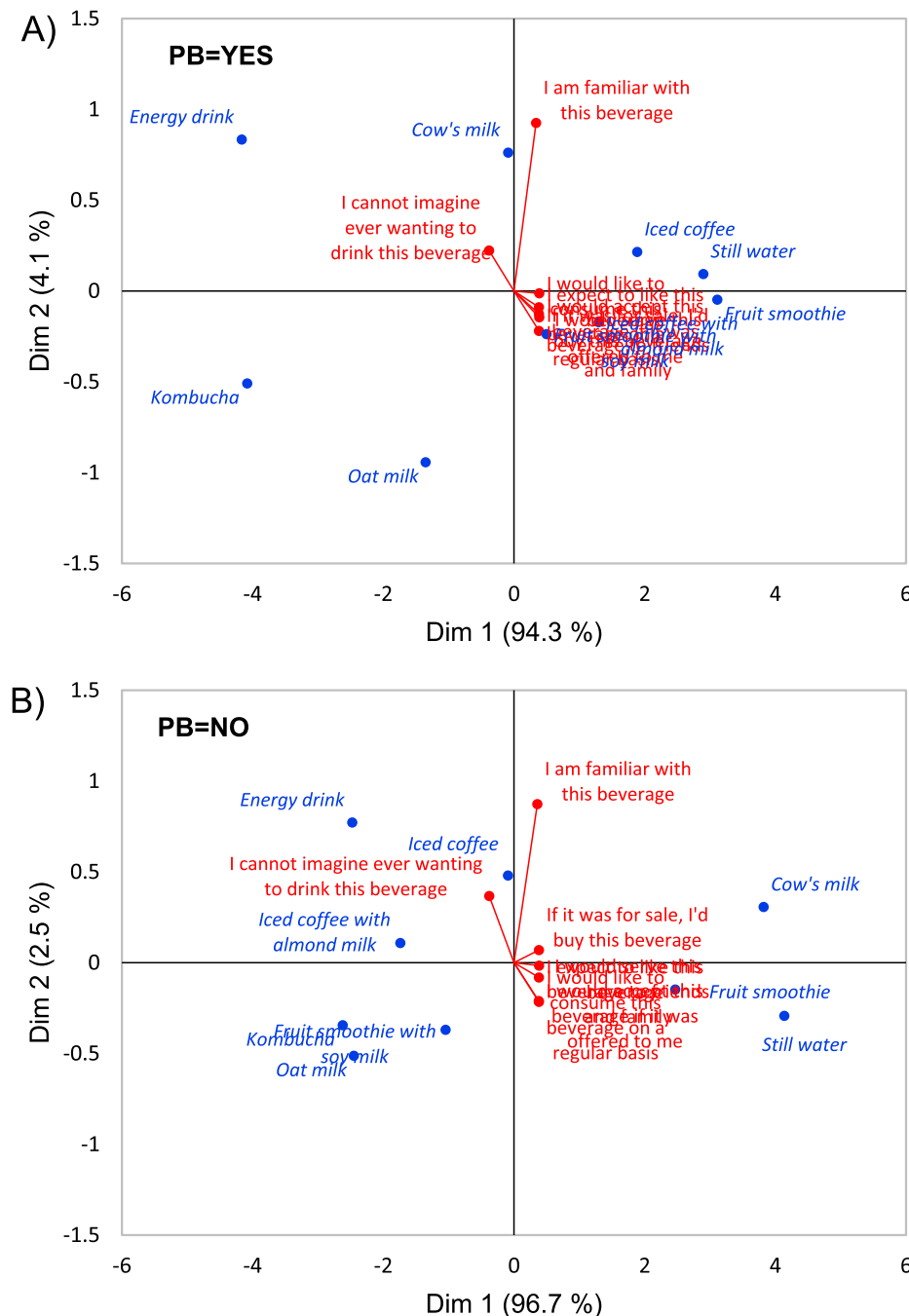


Fig. 5. Two-dimensional spaces (Dim. 1 vs. Dim. 2) following Principal Components Analysis of responses to attitudinal statements. The beverage names (italic font, blue) and situational uses (regular font, red) are shown together in a bi-plot. A) “PB use” consumer group ($n = 249$) and B) “not PB” consumer group ($n = 274$). Refer to Table 1d for the full list of variables. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

flavours should be considered, based on the “ketchup principle,” whereby familiar flavours increase children’s willingness to taste novel foods (Pliner & Stallberg-White, 2000). Consider, for example, flavoured milk which is an already popular category in the USA, and still experiencing growth (e.g., Mordor Intelligence, 2020). Chocolate flavour is particularly popular, and this may be one way of getting to product trial, achieving it through a flavour that is already familiar and liked. The use of locally grown plants may also promote familiarity, and probably all of the products that PB milk alternatives are currently made of can be grown somewhere in the USA. Reduced price could positively contribute to uptake since this is a factor of greater concern for neophobic individuals (Jaeger, Roigard, et al., 2021). Conversely, placing emphasis on environmental or health benefits of PB beverages is unlikely to

contribute strongly toward uptake since these factors are generally less important food choice motives among food neophobes (Jaeger, Roigard, et al., 2021).

A notable aspect of the results in relation to FN was that it extended to all beverages, *Still water* and *Cow’s milk* excluded (Fig. 1, Fig. 6). This fitted with the notion of a pervasive rather than limited effect of FN (e.g., Jaeger, Rasmussen, & Prescott, 2017), and in this regard the present results nicely add to the extant literature because they pertain to consumption frequency rather than liking. In the context of increasing consumption of PB beverages, the critical point is that neophobic individuals may not be avoiding the category because it is PB, but because it lacks familiarity.

As category novelty decreases, uptake should begin to increase

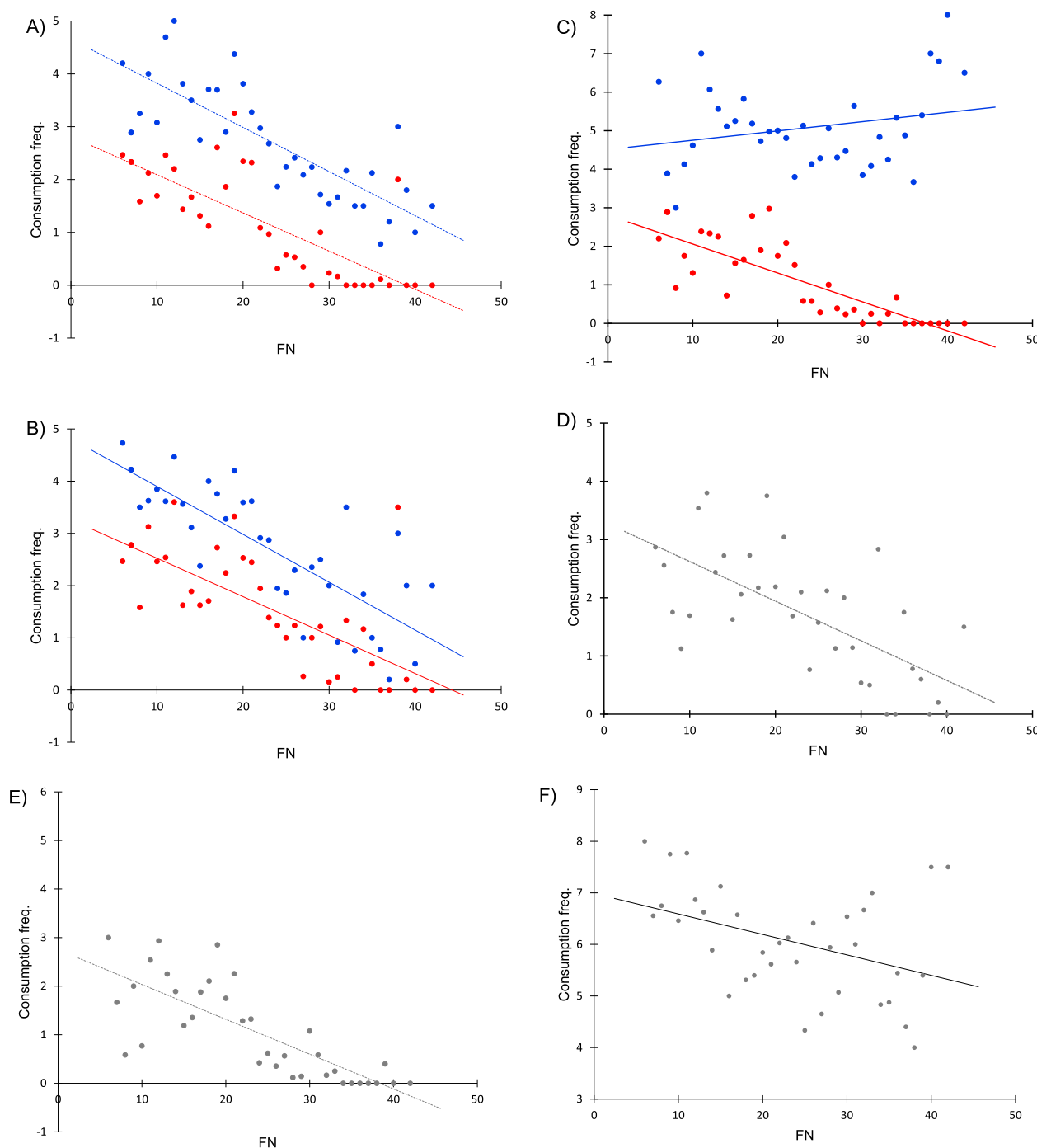


Fig. 6. Linear regression showing the relationship between FN (6 to 42) and consumption frequency for the beverage names included in the study. A) Joint results for *Fruit smoothie* (blue) and *Fruit Smoothie with soy milk* (red); B) Joint results for *Iced coffee* (blue) and *Iced coffee with almond milk* (red); C) Joint results for *Cow's milk* (blue) and *Oat milk* (red); D) *Energy drink* (grey); E) *Kombucha* (grey) and F) *Still water* (grey). Response scale for consumption frequency from 0 = 'never' to 8 = 'once daily or more.' (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

among neophobes, but likely in a variable way because of product-specific interactions between FN and product consumption/liking. This notion is based on evidence that FN effects are variable within product categories. For example, willingness to try ethnic foods among Koreans who were more vs. less neophobic differed in the expected direction for Vietnamese, Indian, Thai, Mexican, Turkish, Greek, Mongolian, African, Japanese and Italian foods, but significant differences was not found for Chinese and American foods (Choe, & Cho, 2011). Among US students, Chung, et al. (2012) found that liking for Korean beverages was more affected by FN than liking for Korean salad dressings, and this

latter finding suggests that even if soy-based alternatives to dairy products increase in popularity and market penetration, FN-specific effects may be observed for milk and yoghurt products based on soy.

4.3. Limitations and suggestions for future research

4.3.1. Beverage selection

The research included nine beverages, and this was a limitation considering that alternatives to cow's milk are much more diverse than those studied here, extending to rice, pea, hemp, flax and many tree nuts

(peanut, macadamia, cashew, walnut, pecan) (e.g., Paul, Kumar, Kumar & Sharma, 2020), many of which are available in unsweetened and sweetened variants, and in different flavours (e.g., cocoa, orange-mango). The associated nutritional and sensory differences (e.g., Walsh & Gunn, 2020) were not accounted for in the product names used as stimuli in the present research, but they can nonetheless influence other aspects of product experience (e.g., De Pelsmaeker, Schouteten, & Gellynck, 2013).

A wider selection of non-alcoholic beverages is also warranted. This could include other products where cow's milk is replaced by non-dairy alternatives (e.g., cappuccino, coffee late, chai late, drinking yoghurt) and/or extend to a broader part of the overall product space, for example, by including popular beverages (e.g., hot coffee, herbal tea, vitamin water, sugar sweetened carbonated beverages, 100% fruit juice). Successful functional beverages would be an obvious target for inclusion also, considering that these are often associated with novel ingredients and/or production methods (e.g., De Koning et al., 2020). The use of product images could be useful in this regard.

The present research was situated in the context of needing global progress toward healthier lifestyles and greater sustainability in global food production, and this motivated the comparison of the "PB use" and "not PB" groups. However, it is possible to analyse the data through a product-specific lens and compare use and non-use groups for each of the PB beverages. For example, the 199 participants who stated they had previously consumed *Oat milk* could be compared with the 399 who said they had not, hereby providing more specific understanding of barriers to uptake of *Oat milk*. A further step in this direction would be to focus on *Oat milk* as an alternative to *Cow's milk* by comparing users ($n = 187$) and non-users ($n = 187$) of *Oat milk* among the 544 people who in the past had consumed *Cow's milk*.

4.3.2. Food neophobia

A limitation was that effects of FN were only studied only in relation to the consumption frequency data, but could reasonably have been extended to all multi-variable responses. Aside from making the paper extremely long, reporting on such analyses would only be sensible for research that is primarily focused on FN. Further, such additional analyses would likely have required implementation of an extreme groups approach which is attracting criticism because it does not treat FN in accordance with its continuous nature (Preacher et al., 2005). Considering future research relevant to FN and the avoidance of new foods, the scale recently introduced by Nezelek, Forestell and Cypryńska (2021) wherein approach and avoidance motivation and interest in novel foods are treated as two separate constructs merits consideration. It would be interesting to know how PB beverages fare in this regard, especially where interest centres on overcoming barriers to consumption.

4.3.3. Sensory properties vs. consumption barriers

Across a wide range of people, neophiles and neophobes included, sensory properties are consistently reported to be a key driver for what to eat and drink on a daily basis (e.g., Onwezen, et al., 2019; Jaeger, Roigard, et al., 2021). Their exclusion from the present research was deliberate but is nonetheless a limitation, and future research with tasted samples is warranted. The multi-response approach used in the present research is well suited to this task, as it can easily be extended to include sensory product evaluation, as shown by Jaeger, Xia, et al. (2019). Here, New Zealand male beer consumers evaluated samples with regard to sensory, emotional, and cognitive responses and the general versatility of the multi-response paradigm was further emphasised by Jaeger, Jin, et al. (2020). The purpose of an extension to the present research that includes sensory product evaluations is not so much to "just" have another set of product responses, but to harness the opportunity the sensory data offers for establishing drivers of emotional, conceptual and situational responses. This is highly sought after. For example, in the last decade, a substantial amount of research has been devoted to understanding how sensory product aspects of foods and

beverages relate to the emotions experienced during consumption (Spinelli & Jaeger, 2019). Thomson, Crocker and Marketo (2010) have shown that systematic linkages can exist between the sensory characteristics of products (e.g., chocolate) and their conceptualisations.

Beyond establishing linkages between sensory characteristics and each of the non-sensory data sets (Table 1), the deeper insight would lie in establishing whether there is concordance between these sets of linkages such that a consistent set of insights can be identified. In this regard, consideration needs to be given to whether the beverage samples are presented in blind or informed condition (i.e., samples accompanied by product labels/branding) for sensory evaluation by consumers, as this has the potential to influence responses (Jaeger, Worch et al., 2021; Lee, Choe, Seo and Hong 2021). There could also be the option to consider variants of PB alternatives, such long shelf-life vs. fresh soy milk. Soy milk makers are popular in China, and this may contribute to uptake because of improved sensory properties and the known effect that preparing food increases liking and consumption (e.g., Dohle, Rall, & Siegrist, 2014).

5. Conclusion

Situated within the context of global efforts towards healthy and sustainable dietary habits, the present research explored consumer perception of PB beverages by using a multi-response research strategy that jointly considered emotional, conceptual, situational and attitudinal/behavioural barriers to consumption. This was coupled with a systematic comparison of users vs. non-users ("PB use" and "not PB" groups) which highlighted that barriers extended to all investigated aspects of product experience. In the "not PB" group, the process of achieving uptake therefore appears challenging as resistance is multi-layered and will be harder to break through. Unfavourable sensory properties – real or imagined – likely compound these challenges. Besides focusing on converting non-users into users, considerable heterogeneity was seen in the group of PB users, meaning that opportunities to increase existing consumption and product repertoire exists. To facilitate this, and overcome the limitation of only including nine beverages in the research, additional studies are recommended. Food neophobia exerted its expected negative influence on product evaluations, suggesting that neophobic individuals may not be avoiding the category because it is PB, but because it lacks familiarity.

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CRedit authorship contribution statement

Sara R. Jaeger: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing. **Davide Giacalone:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

All authors declare no conflicts of interest.

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Appendix A. Supplementary Material

The e-component of this article contains supplementary materials in several parts: 1) Participant characteristics; 2) Circumplex emotion questionnaire; 3) Histogram of summed food neophobia (FN) scores; 4) Detailed results for emotional responses following univariate analysis; 5) Sample spaces with 95% CIs for emotional responses following CA; 6) Detailed results for conceptual responses following univariate analysis; 7) Sample spaces with 95% CIs for conceptual responses following CA; 8) Detailed results for situational use responses following univariate analysis; 9) Sample spaces with 95% CIs for situational use responses following PCA; 10) Detailed results for attitudinal and behavioural responses following univariate analysis; 11) Sample spaces with 95% CIs for attitudinal and behavioural responses following PCA. Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodres.2021.110363>.

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