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How important intrinsic and extrinsic product attributes affect purchase decision

Ulrich Enneking [a,*], Claudia Neumann [b,c], Sven Henneberg [c]

[a] *Fachhochschule Osnabrück, University of Applied Sciences, Oldenburger Landstrasse 24, D-49009 Osnabrück, Germany*
[b] *Technical University Munich, Agricultural and Food Marketing, Alte Akademie 14, D-85350 Freising-Weihenstephan, Germany*
[c] *SAM ASAP GmbH, Drachenseestrasse 1, D-81373 Munich, Germany*

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Abstract

We simultaneously evaluated intrinsic and extrinsic product attributes by means of a choice-based conjoint experiment. A sample of 621 consumers tasted three soft drinks and chose the product most preferred. Test products were systematically varied across choice sets with respect to sweetening system, calorie reduction label, price and brand. Choice data and data on consumption patterns, attitudes and socio-demographics were analysed by a conditional logit model. This approach enabled us to model product choice as a function of one intrinsic and three extrinsic attributes and of consumer characteristics. The latter permits market segmentation of preference data. The main results showed that consumers' preferences of sweetening systems are heavily dependent on brand information. Simulations of market shares based on the total sample reveal the preference of sugar over sweetening systems. However, in some specific consumer segments, sugar is not significantly superior to sweetening systems—indicating how useful market segmentation can be in sensory analysis.

Keywords: Purchase decision; Market segmentation; Choice-based conjoint; Soft drinks

1. Introduction and literature review

Traditional sensory analysis, which focuses on intrinsic product attributes alone, is not sufficient to meet the requirements of today's fast moving markets. An optimised product formulation is necessary for a successful innovation, however, consumers are also influenced by extrinsic product information such as brand, price or labelling.

Especially psychologists have long been interested in the effects of the combination of sensory stimuli, both intrinsic and extrinsic, in product evaluation. Studies from Pronko and Bowles (1948a, 1948b, 1949), Brown (1958) and Makens (1965) show the role of brand recognition and preference in both the ability to identify products and the rating of food products on quality and freshness (Sheen & Drayton, 1988). Based on these findings, Allison and Uhl (1964) observed, in a study on the influence of beer brand identification on taste perception, that brand loyal users assigned significantly higher ratings to their preferred brands in an identified test compared to a blind test. Cheng, Clarke, and Heymann (1989) conducted a conjoint analysis with restructured beef steaks and were able to show how three attributes—product preference, packaging and brand identification—influenced the consumer's hedonic responses. Also, Moskowitz (1994) shows in a product-concept test with fat-reduced cheese, how other information, besides the physical characteristics of the products themselves, can modify consumer acceptance. Consumer's stated purchase intent could be increased only by incorporating a health message. Those findings indicate that sensory analysis has to be combined with modern market research methods in order to develop integrated approaches that are able to evaluate extrinsic as well as intrinsic product attributes and possible interactions

* Corresponding author. Tel.: +49 541 9695126; fax: +49 541 969220.
E-mail address: u.enneking@fh-osnabrueck.de (U. Enneking).

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between them. Understanding the relative importance of product attributes influencing food choice at the point of sale is important to the success of new product development. For many years conjoint analysis has been used to estimate the importance of various product attributes for consumers' purchasing decisions (Green & Srinivasan, 1978, 1990). Although the taste of a food product is widely assumed to influence buying decisions, the product attribute "taste" has rarely been incorporated in conjoint analysis. Vickers (1993) describes a conjoint analysis of strawberry yogurt that examined the importance of brand, taste, health claim, and price to buying intent with a multilevel approach.

It was evident at the 6th Pangborn Sensory Science Symposium in Harrogate, that some authors see the future in combining sensory experiences with consumer perception, expectation and attitudes and, therefore, postulate the expansion of the model beyond acceptance.[1] One possibility to meet the demand to combine intrinsic factors, like taste, with extrinsic factors is to use the conjoint method, which was also seen as a future tool for the sensory science.[2]

The objective of this research was to incorporate food tasting into the test design and to evaluate extrinsic and intrinsic product attributes simultaneously. We conducted a choice-based conjoint analysis because this method allows us to examine possible interactions between taste and brand and also allows a segment specific analysis.

2. Materials and methods

2.1. Methodological background

Market research on food choice is predominantly based on conventional surveys where respondents are directly interviewed with respect to brand awareness, price sensitivity, etc. Interviewees' attention is thus strongly directed to specific product features, which increases the danger of overestimating the effect of certain characteristics compared to real market behaviour. In line with this argument, Teichert (2000) has experimentally shown that unimportant product attributes are overestimated by respondents when separately evaluated. This can probably be attributed to a tendency of 'yes saying' observed when respondents want to please interviewers. Overrepresentation of single product features can be reduced when interviewees compare several product attributes and brands within a choice-based conjoint experiment. In this case, respondents are not aware of which attributes researchers are interested in. Furthermore, if respondents are not willing to pay a high product price, they may vote for a cheaper alternative without 'disappointing' the interviewer by choosing no product at all.

Because of these (and other) advantages, choice-based conjoint experiments are increasingly being used in research. In a recent study, Burton, Rigby, Young, and James (2001) calculated willingness-to-pay for several food attributes, namely reductions in chemical use, food risk, and in transportation distance but also a label indicating a voluntary ban on genetically modified ingredients. However, this and other choice-based conjoint experiments have not modelled taste as an experimental variable. The study presented in this paper is the first to evaluate intrinsic (taste) and extrinsic (brand, labelling, etc.) attributes in a single choice experiment.

Choice-based conjoint experiments are usually analysed within a random utility framework which assumes that an individual, n, maximises his or her utility when choosing between alternatives, J. The researcher is not completely informed about all elements considered important by respondents, so utility observed from a researcher's perspective can be broken down into two components, V and ε

$$U_{in} = (V_{in} + \varepsilon_{in}), \tag{1}$$

where

U_{in} is the overall utility of choice i for individual n,
ε_{in} is the random utility component which comprises unobserved individual observations, measurement errors and unobserved attributes,
V_{in} is the systematic or measurable utility, which is a function of $\mathbf{X}_{in}$ and $\boldsymbol{\beta}_i$ and an unknown parameter vector to be estimated. $\mathbf{X}_{in}$ defines: (i) a matrix of attributes that pertain to choice options, (ii) a matrix of characteristics that pertain to individuals, (iii) a matrix of interactions of attributes with individual characteristics or (iv) a vector of interactions of individual characteristics with choice option intercepts (Louviere, 2001). In most practical applications, V_{in} takes a linear-in-parameters additive form.

If A is defined as the universal choice set of discrete alternatives, and J the number of elements in A, then individual n will choose alternative i over some other option j if, and only if,

$$U_i > U_j \quad \text{where all } j \neq i \in A \tag{2}$$

and the probability that individual n chooses i from set A is given by

$$P_{in} = P[\{\varepsilon_{jn} - \varepsilon_{in}\} < \{V_{in} - V_{jn}\}] \quad \text{for all } j \neq i. \tag{3}$$

In order to specify the choice probabilities in (3), assumptions must be made with regard to the distribution of the random components. From the outset of choice-based conjoint experiments (McFadden, 1974), the independent and identically distributed type I extreme-value distribution proved convenient for computational ease. This distribu-

[1] Sensory and consumer science—What have we achieved? Where are we going? Halliday MacFie; Keynote presentation at the 6th Pangborn Sensory Science Symposium.

[2] Sensometrics overview—challenges and opportunities. Pascal Schlich; Keynote presentation at the 6th Pangborn Sensory Science Symposium.

Table 1
Systematically varied product attributes

	National brand	Regional brand	Private label
Price	0,76/0,86/0,96 EURO	0,46/0,56/0,66 EURO	0,26/0,36/0,46 EURO
Labelling	Big label Small label Without label	Big label Small label Without label	Big label Small label Without label
Taste	100% sugar 67% sugar Conventional sweetener Diet sweet Up™	100% sugar 67% sugar Conventional sweetener Diet sweet Up™	100% sugar 67% sugar Conventional sweetener Diet sweet Up™

tion leads to the popular multinomial (conditional) logit model (MNL)[3]:

$$P_{in} = \frac{e^{V_{in}}}{\sum_{j=1}^{J} e^{V_{jn}}}, \quad j = 1, \ldots, J, \; j \neq i. \tag{4}$$

2.2. Survey and data

From April to June 2004, 621 consumers of carbonated soft drinks participated in the choice-based conjoint experiment, which took place in the region of Munich, Germany. The data were collected in shopping centres and in a sensory laboratory using personal computer assisted interviews.[4] The interview was divided into an experimental part and 'a questionnaire part', beginning with the experimental choice task. In an identified test, participants were asked to taste three carbonated soft drinks (CSD) with orange flavor and to choose the most preferred from a specific 'choice set'. Each choice set is a different combination of several product attributes. In order to design those choice sets, the 'mix and match' approach, described in Chrzan and Orme (2000), was employed, which permits estimation of the main effects as well as first order interaction effects (i.e. brand * taste). The choice modelling literature recommends at least 500 choices to allow for valid maximum likelihood estimations (e.g. Long, 1997). Therefore, choice tasks were repeated twice by respondents in the shopping centres and five times by consumers in the sensory lab. Having deleted a few outliers from the sample, a total of 1529 choices was ready for analysis.

The products offered to respondents varied systematically with respect to taste, brand, labelling and price (Table 1).

The first product is an international premium brand which is distributed nation-wide and marketed with the aid of TV advertising. The second brand represents a medium-priced product distributed on a regional level. Our third brand represents a low-priced private label and acts as a reference category in the statistical model. Prices were varied across all three brands using three brand-specific price levels. In addition to brand and price, a calorie reduction label was varied across the product by using either a big label, a small label or the product was shown completely without a label. To include the intrinsic product attribute "taste" into the choice set, we used four different sweetening systems to sweeten the CSD: 100% sugar, 67% sugar, a conventional sweetener (consisting of a sweetener mixture) and Diet Sweet Up™, a new improved sweetener mixture. These taste variants did not correspond to the original tastes of the three brands displayed to respondents. All extrinsic product information on brands, prices and calorie reduction labels was presented via photographs (Fig. 1).

In addition to the experimental design, a decision had to be made on whether or not a no-choice option should be included into the choice design. On one hand, such a base alternative leads to better predictions of market penetration and is considered more realistic since, in many purchase situations, consumers can defer purchase or purchase elsewhere. On the other hand, the base alternative gives no information about the impact of label and price on choice.[5] Furthermore, Dhar (1997) shows that when alternatives are similar in preference, respondents will choose the no-choice option more often as compared to when alternatives are very distinct from each other. In this paper, respondents were not offered an opt-out alternative because the tendency to choose none of the products seems to be rather weak: First, only users of CSD with orange flavor were interviewed, implying a general acceptance of this product category. Moreover, the selected products covered most 'types of preferences' in this product category, leading to very low incentives to opt for a no-choice category. Second, most consumers are not highly involved when buying carbonated soft drinks, thus deferring purchase or buying elsewhere will probably not

[3] For an exhaustive derivation of the MNL model see Louviere, Hensher, and Swait (2000, 45ff).

[4] Potential differences between the sub-samples interviewed in shopping centres ($N = 520$) and those consumers who were invited to the sensory lab ($N = 101$) are not analysed in this paper. They are going to be discussed in a separate publication.

[5] For a more detailed discussion of the no-choice alternative in choice-based conjoint/discrete choice analysis, see Haaijer, Kamakura, and Wedel (2001).

Fig. 1. Choice set.

be a real option for them. Thirdly, it is not the purpose of this study to predict market penetration, which is often quoted as an important argument to include a no-choice option.

The experimental part of the interview was followed by questions on the respondent's personal characteristics and purchasing motives/patterns. Age and size of the household were personal factors we've collected to explain their influence on decision making. Since we expected product choice to be influenced by the occasion on which consumers drink CSD, respondents who drink CSD mainly on the way, or during a workout were identified by the variables *way* and *sports*. To explain product choice at the point of purchase, factors such as brand loyalty, price orientation and—in the specific case of CSD—the sugar content may also be important. Therefore, we asked consumers which factors are most important for them when buying CSD. Furthermore, consumers are not all acquainted with exactly the same products because they use different distribution channels. It can thus be hypothesised that, ceteris paribus, a preference for shopping in the supermarket increases the probability to choose the premium brand. For that reason we have distinguished between consumers who prefer shopping for CSD in supermarkets, beverage stores and at filling stations. All variables we have modelled in the present study are displayed in Table 2.

2.3. Statistical analysis

Based on the described variables, a conditional logit model was estimated by the software package STATA 7.0. Having compared several linear utility functions of the conditional logit model, the specifications displayed in Tables 3 and 4 respectively were chosen based on LR tests. By means of a Hausmann test, the assumption of independence of irrelevant alternatives could be affirmed. Tables 3 and 4 show the brand-specific estimators (logit coefficient) of the experimental and of the exogenous variables. In the remaining sections, the results will be discussed focusing on brand-specific effects.

Table 3
Estimation results (t-ratios in parentheses)

	National brand	Regional brand	Private label
Label_small	0.33 (2.04)	−0.04 (−0.3)	−0.23 (−1.6)
Label_big	0.24 (1.47)	0.31 (2.17)	0.08 (0.6)
Taste_67%	−0.74 (−3.94)	−0.70 (−4.12)	−0.55 (−3.45)
Taste_dietsweetup	−0.39 (−2.33)	−0.55 (−3.56)	−0.26 (−1.61)
Taste_conventional	−0.82 (−4.4)	−0.90 (−5.56)	−0.58 (−3.57)
Constant	0.29 (0.78)	0.28 (0.83)	
Household	−0.03 (−0.77)	−0.08 (−2.01)	
Supermarket	−0.00 (−0.01)	0.38 (3.03)	
Filling station	0.04 (0.15)	−0.62 (−1.93)	
Price	−0.69 (−3.7)	−0.29 (−1.76)	
Brand	0.73 (3.4)	0.28 (1.39)	
Sugar	−0.54 (−2.7)	−0.22 (−1.31)	
Age	−0.14 (−2.1)	0.04 (0.72)	
Way	−0.34 (−2.43)	−0.28 (−2.32)	
Sports	0.54 (2.41)	0.13 (0.66)	

Number of obs = 4587; LRχ^2 = 294.29 (p = 0.0000); log likelihood = −1532.6318.

Table 2
Summary of exogenous variables in the estimated models

Question wording	Variable name	Scale	Mean
Where do you prefer shopping for CSD?			
Supermarket	Supermarket	0/1	0.39
Beverage store	Beverage store	0/1	0.40
Filling station	Filling station	0/1	0.41
When buying CSD I pay attention to...			
...price	Price	0/1	0.51
...brand	Brand	0/1	0.11
...sugar content	Sugar	0/1	0.44
When do you drink CSD?			
...on the way	Way	0/1	0.47
...during work out	Sports	0/1	0.13
How old are you?	Age	0–4	2.80
How many people live in your household?	Household	1–9	2.61

Table 4
Estimation results for sub-segment of calorie sensitive consumers (t-ratios in parentheses)

	National brand	Regional brand	Private label
Label_small	0.32 (1.1)	0.21 (0.88)	0.15 (0.62)
Label_big	0.19 (0.7)	0.69 (2.72)	0.39 (1.61)
Taste_67%	−0.86 (−2.57)	−0.66 (−2.31)	−0.00 (−0.01)
Taste_dietsweetup	−0.46 (−1.58)	−0.35 (−1.3)	0.04 (0.18)
Taste_conventional	−0.85 (−2.69)	−0.82 (−2.9)	−0.59 (−2.06)
Constant	0.41 (0.75)	0.57 (1.14)	
Household	−0.08 (−0.96)	−0.17 (−2.23)	
Beverage store	0.29 (0.94)	0.78 (2.95)	
Brand	1.22 (3.47)	−0.15 (−0.4)	
Age	−0.25 (−2.16)	−0.06 (−0.62)	

Number of obs = 1581; LRχ^2 = 106.11 (p = 0.0000); log likelihood = −525.9114.

3. Results and discussion

Analysing all choice decisions made by consumers in the two separate samples, we found significantly high negative effects for all alternative sweetener systems as compared to the reference category '100% sugar' (Table 3). This is true for all three different brand segments. This indicates that sugar remains the 'queen of sweeteners'. Additionally, the fact that the estimated t-values are much higher compared to other model variables reveals a considerable impact of taste on product choice. As for the calorie reduction label, the impact is not that clear. Interestingly, only the choice probability of the national brand increases significantly (t-value = 2.04) when attached with a small label, whereas the regional brand is the only product in the choice set which significantly profits from a big calorie reduction label. We can not explain this phenomenon by the information collected within this study. The results may be influenced by design aspects. Nevertheless, the estimated coefficients generally suggest that there is a (brand specific) positive labelling effect on product choice.

As was shown in Table 1, a brand-specific price was also included as an experimental variable. However, no significant influence of price on the product choice decision could be estimated, so this variable was dropped from the estimated models. The simultaneous evaluation of intrinsic and extrinsic product attributes may have led to this finding. Since consumers usually do not evaluate both taste and marketing attributes at the point of purchase, interviewees may have overvalued taste compared to price. This interpretation is confirmed by an unpublished study where respondents had to make a choice between the same products. However, the three products were only varied with respect to extrinsic attributes. This test partly showed a significant influence of price on brand choice.

Apart from experimental and product specific variables which can be systematically varied by researchers, some individual specific variables were used to model preferences. This approach permits a deeper understanding of brand choice and gives marketers important information for market segmentation.

Respondents who judged themselves as price sensitive have a significantly lower probability to choose the premium national brand compared to the private label. The opposite is true for those who pay attention to brands. Interestingly, respondents who look out for sugar content prefer the private label over the national brand. Probably, the premium brand, which rather attracts younger consumers, is conceived as a sweet CSD. The model also reveals that the place of purchase has a significant effect on product choice. Respondents who primarily choose the supermarket as place of purchase prefer the regional brand whereas consumers who buy CSDs at filling station behave in the opposite way. Apart from age, sociodemographics do not have a big impact on product choice.

With the chosen conditional logit model, it is also possible to focus on subsets of the total group of consumers. Through our questionnaire, we analysed consumer attitude toward calorie reduced products and were able to identify 34% of the total group as calorie sensitive consumers. This group can be seen as the target group for a new calorie reduced orange flavored CSD. For this subgroup of consumers we found that 67% sugar and Diet Sweet Up™ can compete with sugar for the private label segment (Table 4). Compared to the conventional sweetener, all other considered sweeteners are better in the eyes of real consumers.

By looking to the results for the calorie reduction labels (Table 4), we find a clear indication that labelling improves the probability to choose each of the three considered brands. The bigger the label the more gain in market shares can be expected.

We conclude that the considered subgroup of calorie sensitive users of orange flavored CSD prefer even new improved sweetening systems over pure sugar products if they are clearly indicated as calorie reduced products. Hence, the development of new sweetening systems allows calorie reduced CSDs to invade even the premium segment. Moreover, calorie reduction is a feature that is relevant in all market segments (premium, regional brand, private label). As calorie sensitive consumers react favorably to new sweetening systems if they are clearly labelled, the results indicate that a new sweetening system should not substitute a 100% sugar product. A diversification addressing one third of the potential buyers of CSD should be preferred.

4. Conclusion

Choice-based conjoint methods applied to sensory market research allows a focus on markets and consumer segmentation. With the chosen model, we could analyse a subgroup that is interesting in terms of a diversification of the orange flavored carbonated softdrinks market. This calorie sensitive consumer group has no significant preference for sugar compared to new sweetening systems. New sweeting systems combined with labelling the product as calorie reduced will enhance the probability of choice of

the respective product. This result is valid also for the national brand segments, which indicates a possibility for new sweetening systems to invade even the premium market segments. The choice-based conjoint method is a new approach to analyse interesting segments of consumers. However, from a methodological point of view, it has to be mentioned that a simultaneous evaluation of extrinsic and intrinsic product attributes seems to be quite demanding on respondents and, therefore, unsuitable for pricing research. However, respondents showed considerable brand-specific taste evaluations. By combining intrinsic (taste) and extrinsic factors (brand and labels), we can describe not only main effects, but also interactions between taste and marketing mix elements, allowing us to determine key drivers for product preference. Future research might be conducted as a two step evaluation of consumer preferences where pricing research is a separated task. This is expected be less demanding on respondents and will probably enhance data quality.

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Case Studies

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Switzerland

SAM Sensory and Marketing International AG
Seeblick 1
CH - 6330 Cham
Phone: + 41 44 439 70 40

SAM Sensory and Marketing Switzerland AG
Albulastrasse 57
CH - 8048 Zürich
Phone: + 41 44 439 70 40

info@samresearch.com

Germany

SAM ASAP Sensory and Marketing Germany GmbH
Drachenseestrasse 1
D – 81373 München
Phone: + 49 89 743 76 70

N7,6
D – 68161 Mannheim
Phone: + 49 621 42 28 90

Brandstwiete 1
D – 20457 Hamburg
Phone: + 49 40 32 50 83 60

samger@samresearch.com

Italy

SAM Sensory and Marketing Italy s.r.l.
Viale Monza, 270
I - 20128 Milano
Phone: + 39 02 27 00 70 19

Via Santi 5
I - 43040 Lemignano di Collecchio (PR)
Phone: + 39 05 21 80 45 35

infoit@samresearch.com

France

SAM Sensory and Marketing France S.A.R.L.
16, rue Martel
F - 75010 Paris
Phone: +33 1 48 24 61 00

infofra@samresearch.com

Spain

SAM Sensory and Marketing Spain, S.L.
Aragón, 270, 03 – 01
E – 08007 Barcelona
Phone: +34 93 467 64 60

infospainamresearch.com