



A SYSTEMATIC REVIEW OF FOOD PRODUCT CONJOINT ANALYSIS RESEARCH

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ABSTRACT

Objectives: Conjoint research techniques have been employed in many articles. These are mainly in the field of food sciences. There has yet to be a thorough analysis of these papers. Reviewing food product conjoint analysis articles was the goal of the current literature review. **Methods/Approach:** A systematic literature review approach was used based PRISMA approach. **Results:** Published between years 2000 to 2020, 72 articles were reviewed. The article focussed on average sample size, most common subsampling methods, differences in conjoint evaluation questions, and most tested product categories. As a result of these findings, the author brought out steps to take when planning to conduct conjoint analysis and highlighted gaps in the current literature. **Conclusions:** 62 articles focused on hedonic goods and 38 on extrinsic qualities. Insights from this review champion conjoint analysis as an indispensable tool, highlighting its potential to refine future research endeavours in the domain. Results and supporting data from conjoint research conducted on utilitarian products still need to be included. The median sample size was 298, while the average was 459.

Keywords: Product package design, conjoint analysis, experiment design, systematic literature review

JEL classification: M31, M00, M39

Paper type: Research article

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INTRODUCTION

Numerous different attributes and components of package design have been the subject of research. Package design is a marketing communication medium that has received some attention in earlier literature. Extrinsic characteristics of different package designs, including color (Grunert, Mueller, Zhou, & Tinggaard, 2015), shape (Puyares, Ares, & Carrau, 2010), brand (Lee, Lusk, Miroso, & Oey, 2015), and nutrition claims (Ares et al., 2016), have all been examined in the context of consumer behavior.

A product's or package's design is a combination of different attributes. Conjoint analysis is a suitable research method to analyze how combining these attributes could make up a design that best fits the target audience. Conjoint analysis is a popular research method in marketing (Chakravarti et al., 2012). A search conducted on March 8, 2021, for the term "conjoint analysis" yielded over 73000 results in Google Scholar. The method is just as popular commercially, with over 1000 research done annually in the 1990s (Sattler Hensel-Börner, 2001), and the number has risen over the years.

This paper focuses on reviewing food products' conjoint analysis research. There have yet to be any studies reviewing food product conjoint research. There are however review papers on food products or on conjoint



research. Local food preference research has been reviewed by (Feldmann & Hamm, 2015), and papers looking at package designs' effect on consumer behaviour have been reviewed by (Vieira, Alcantara, Prado, Pinto, & Rezende, 2015). From a conjoint review perspective (North & Vos, 2002) looked at conjoint research in the context of consumer buying preference; (Marshall et al., 2010) looked at conjoint applications in health, and (Agarwal, DeSarbo, Malhotra, & Rao, 2015) reviewed conjoint research in an interdisciplinary perspective. Asioli and colleagues (Daniele Asioli et al., 2017) look at products' intrinsic and extrinsic attributes, also reviewing conjoint analysis papers in the process. While these reviews delve into conjoint research or food product research, a gap persists in our understanding of its application specifically within food product research. This paper aims to systematically review food product conjoint research. This paper champions the continued use of conjoint analysis. As evidenced throughout this review, conjoint analysis is not merely a widespread method across various fields, but it emerges as a pivotal tool in food research.

Conjoint analysis is a broad term used to cover different ways to research preferences (Louviere, Flynn, & Carson, 2010). “Conjoint Analysis (CA) is a method that is widely used to measure and predict choices and preferences of a specific group of users” (Orzechowski, Timmermans, & Vries, 2000, p. 279). However, while preference is asked in classical conjoint analysis, other inputs like purchase intent and perceived healthiness have also been used. In conjoint analysis, people evaluate several “cards ” factorial attribute designs. These cards can be anything, but in food science and marketing, they usually tend to be food products or packages.

In the first stage of conjoint research, a researcher will identify the critical attributes of a product they want to research (Orzechowski et al., 2000). There is no consensus in the way to choose the attributes (Louviere et al., 2010). After attributes are chosen, an orthogonal design (orthogonal fractional array) is created with a set of products, or “cards”, all with distinct attribute levels. Then these cards are presented to the respondents, who are asked to state their preference for each card on a scale (Orzechowski et al., 2000). Alternatives could have respondents rank the cards or, in some setups, choose from pairs presented to them. Based on this, the sample's preference for every attribute and its level is calculated. The stages of decisions needed to conduct conjoint analysis are summarized by (North & Vos, 2002): (1) selecting product attributes; (2) determining the attribute levels; (3) determining the attribute combinations; (4) selecting a form of presentation of stimuli and the nature of judgments to secure from respondents; (5) selecting an analysis technique.

A preliminary review of the pertinent literature led the author to identify six key areas that will be covered in this review (brought out as research questions after figure. A flowchart of steps to conduct conjoint analysis is proposed. This is followed by discussion and conclusions. No specific attention is paid to the analytical side of conjoint analysis. This paper also leaves out the specific theoretic assumptions and consumer behavior models underlying the research.

METHODOLOGY: LITERATURE REVIEW CONCEPT AND APPROACH

This systematic literature review is based on a combination of 3 review approaches. A preliminary review was conducted (developing research questions, identifying articles and synthesising data) based on the logic



proposed by Tranfield and colleagues (Tranfield et al., 2003) who have applied systematic literature review to management studies and Durach and colleagues (Durach et al., 2017) who have done the same in supply chain management (Figure 1). The systematic literature review is based on an extensively used PRISMA flowchart framework published by Moher and colleagues (Moher et al., 2009). The amount of scientific material on conjoint research calls for a clear focus and systematic exclusion of some papers. For this reason, the search for articles was limited to the Science Direct database. Though an artificial filter, it limits the number of papers and covers many essential food journals



Figure 1. Literature review process stages

Source: developed by the author based on (Tranfield et al., 2003; Durach et al., 2017)

Formulating the review question is the first critical element of any systematic literature review (Durach et al., 2017). In the context of this paper, the author is interested in articles that look at food products and package design using conjoint research methods. Based on the initial screening of the papers, the most important empirical topics from these formed the basis for the following literature review research questions:

1. What is the average sample size of conjoint analysis;
2. Are there any subsampling methods used in conjoint analysis, and if yes, then what are the most common methods used;
3. What product evaluation questions are used when consumers have to evaluate conjoint alternatives, and are questions are most commonly used in conjoint research;
4. On which product categories conjoint research is mainly conducted;
5. Is most conjoint research conducted on extrinsic attributes, or are intrinsic attributes also analysed;
6. How similar or different is the general conjoint research flow, and could some generalised suggestions be brought out similarly (North & Vos, 2002)?

The literature search was conducted in March 2021 using the Science Direct database, focusing on food sciences and marketing field articles. The systematic review was based on the keywords: “conjoint research”



and “conjoint analysis”, combining these with the terms “food” and “package design.” The first search resulted in 7460 papers without duplicates. Six hundred forty-six research articles were screened. The review process flowchart is seen in Figure 2. Only papers in English, in food science or marketing, were included.

Further analysis and reading of the papers cut that number to 72 articles, as other articles did not include first-hand conjoint analysis or did not include any empirical results from the conjoint analysis. These articles were then coded into a spreadsheet by article authors, year, product, sample size sub-sampling methods, evaluation question type, product type (hedonic/utilitarian) and product attributes.

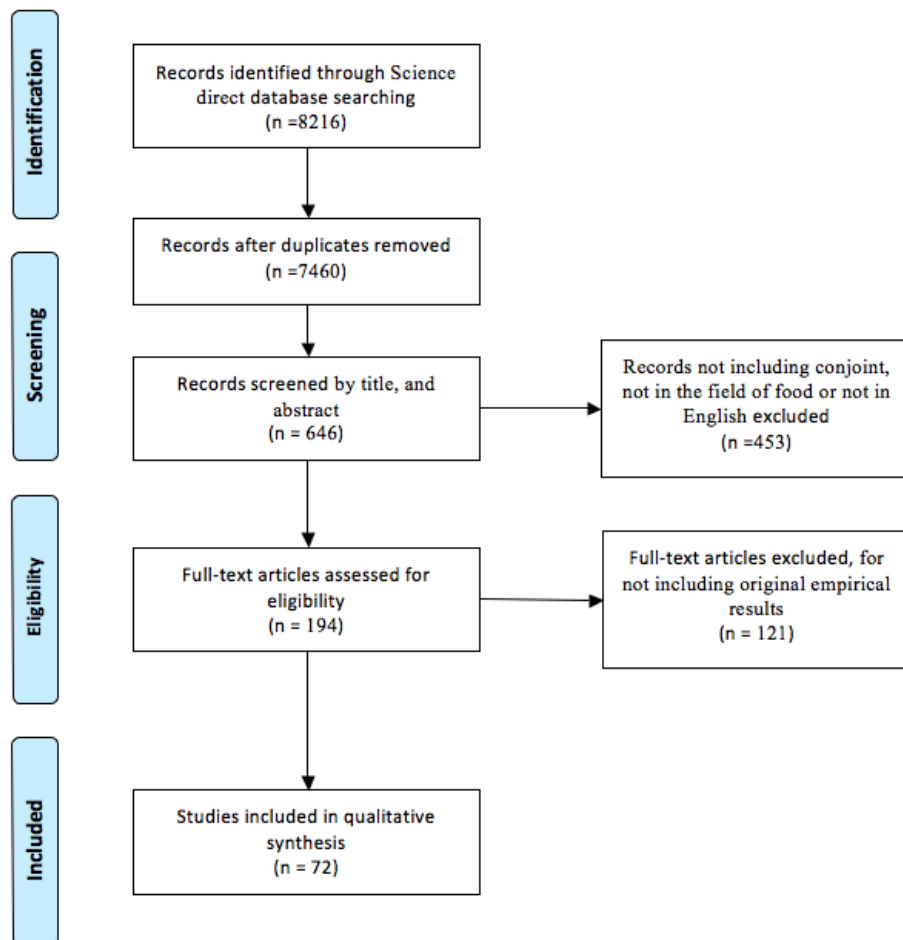
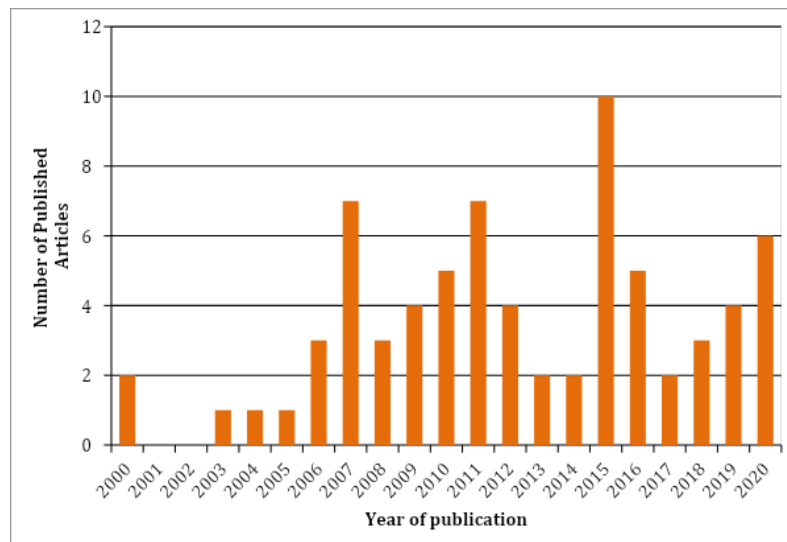


Figure 2. Conjoint article selection process PRISMA flowchart

Source: developed by the author based on Moher and colleagues' work (Moher et al., 2009).

The 72 conjoint analysis papers included in the review were from 2000 to 2020 (Graph 1). This paper's number of articles per year stems mainly from the excluding process. These numbers only highlight the years covered in the review, and no other conclusions should be drawn from this. There is an apparent lack of articles from years 2001-2002. This was the case in the search results conducted in march 2021. This does not mean that no conjoint research on food products has been done in this period, but rather, the search did not result in articles from that period.



Graph 1. The number of reviewed articles per year for the reviewed period.

Source: developed by the author

RESULTS

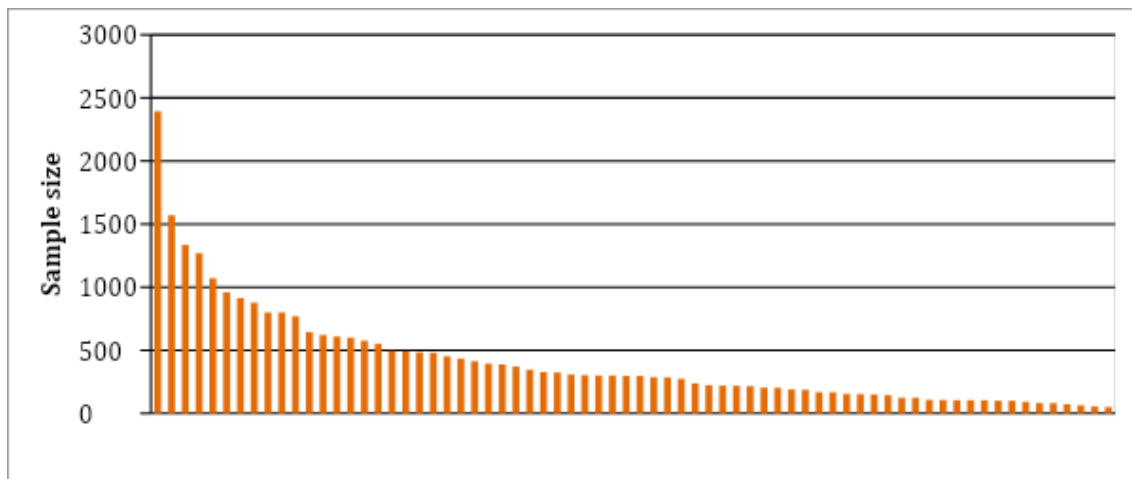
3.1 Sample size distributions and sub-sampling methods dealing with heterogeneity

The preliminary review of articles showed a substantial difference in sample sizes. This was the motivation to investigate how much sample sizes vary. With the smallest sample size of 50 and the largest sample size of 7790, there was a wide range in the sample size. This is due in part to different data collection methods, including face-to-face conjoint analysis, small university-based surveys, and extensive online survey populations. Table 1 displays the mean and median of the reviewed papers samples. These were computed both with and without an outlier. Given the disproportionate influence of the study by Charette, Hooker, & Stanton (2015) with a sample size of 7790 which is three times larger than the next-largest study - it was deemed an outlier and removed to ensure a more representative overview of the typical sample sizes in the reviewed papers. As a result, instead of an average sample size of 514, a more accurate indicator is an average of 355. The majority of the samples are below 500, as can be seen from the distribution (Graph 2). Only six papers have a sample of more than 1000, with half the papers with a sample lower than 300. The papers with a sample over 1000 or fewer than 100 were considered outliers in Table 1.

Table 1. Sample statistics of the reviewed 72 papers

	With outlier	Without outliers
Average	514,3	355
Median	297	298,5

Source: developed by the author



Graph 2. The reviewed 72 conjoint articles sample sizes

3.2 Subsampling methods

Consumer behaviour studies with primary data can suffer under sample heterogeneity. There are a high number of articles in this review that address this. Consumers differ regarding their preferences and the intuitive logic patterns behind their answers. Consumer research sample heterogeneity has been clearly shown (Baumgartner & Steiner, 2007; Jansen, Menichelli, & Næs, 2015; Lim, Currim, & Andrews, 2005; Otter, Tüchler, & Frühwirth-Schnatter, 2004; Voleti, Srinivasan, & Ghosh, 2017). To solve this, different subsampling methods have been used.

Thirty-nine articles used a subsampling method to deal with the heterogeneity within the sample. Thirty-two articles used ex-post subsampling methods (Cunha et al., 2016; de Jonge, van der Lans, & van Trijp, 2015; Endrizzi et al., 2015; Grunert et al., 2015; Lee, Lusk, Miroso, & Oey, 2015 see appendix A for complete list). Some type of cluster analysis was the most used of the different subsampling methods, with other methods only used once or twice among the papers. (Table 2).

Table 2. The *ex-post* subsampling methods and the number of used instances.

Subsampling method	Nr of instances used
Some form of clustering	23
Clustering (Not specified approach)	18
Ward hierarchical cluster analysis	2
Latent class choice modelling	2
Fuzzy clustering	1
Mixed model ANOVA and fuzzy clustering	1
K-means clustering	1
Turkey's multiple comparison tests	1
Multivariate individual differences	1
Mixed ANOVA and mixed logit	1



Latent class multinomial logit	1
Conditional logit model	1
Bayesian distance	1
ANOVA and Factor analysis	1
Number of articles using subsampling	32

Source: developed by the author

Ex-post sampling almost always brings out clusters within the sample whose answers differ. The clusters generated by *ex-post* sub-sampling are not easily definable and challenging to use in product design. Ten papers used demographic, behavioural or some other sample descriptive data that has been collected before or right after the conjoint test to do *ex-ante* subsampling (Bernabéu, Prieto, & Díaz, 2013; Kildegaard et al., 2011; van der Zanden, van Kleef, de Wijk, & van Trijp, 2015 for the complete list see appendix A).

Table 3. Number of instances where different *ex-ante* subsampling methods were used

<i>Ex ante</i> sub-sampling methods	Nr of instances used
Involvement-based triadic split procedure	4
Socio-demographic	2
Pre-test survey-based clustering	1
Non-Parametric Combination of Dependent Permutation Tests	1
Geographical	1

Source: developed by author

The smallest samples that cluster analysis was applied to was a sample of 81 participants (Hersleth, Lengard, Verbeke, Guerrero, & Næs, 2011) and (Ares, Giménez, & Gámbaro, 2009) a sample of 82. This shows that even for samples of around 100 participants, some subsampling techniques like cluster analysis can help deal with sample heterogeneity (Table 4). Subsampling should be considered even with small samples.

On the other hand, these subsampling methods (clustering in particular) rarely fail to give some resulting sub-samples. Some subsamples with more homogeneity than the full sample can always be found. There has been a fair share of critique in the literature for how clustering has been used. Most of these critical points also apply here in the context of reviewed conjoint analysis. Cluster analysis provides groups and fails to reject the null hypothesis when no natural groupings are present in the data (Balijepally et al., 2011). Clustering provides some sort of cluster even if no meaningful groups are embedded in a sample (Barney & Hoskisson, 1990). The number of clusters is often not explained, and no attention is put on stability and internal validity (Dolnicar, 2002).

Table 4. Articles with the smallest sample sizes that applied some sort of subsampling methods

Author of the article	Sample size
(Hersleth et al., 2011)	81
(Ares et al., 2009)	82



(Kälviäinen et al., 2003)	92
(Martínez-Carrasco Martínez, Brugarolas Mollá Bauzá, Del Campo Gomis, & Martínez Poveda, 2006)	100
(Lockshin, Jarvis, D’Hauteville, & Perrouty, 2006)	100
(Næs, Kubberød, & Sivertsen, 2001)	104
(Menichelli, Veflen, Meyer, & Næs, 2012)	105
(Ares & Deliza, 2010)	105

Source: developed by author

Furthermore, *ex-post* subsampling methods, like clustering, can be challenging for applied research and business implications. Part-worth-utilities-based clustering can give subsamples that behave the same way in their choices. However, the results are not applicable if they have no common socio-demographic characteristics. Some groups of people choose lemon over lime and are willing to pay more, but they might have no socio-demographic standard features. Who are they, and how to address them or cater to their needs? Hence both subsampling methods come with their drawbacks.

The conclusions are two-sided. When conducting conjoint research, sub-sampling is a useful technique to understand the results better. Ex-ante sub-sampling is better for research that drives for practical implications, as the (often demography-based) samples are easier to identify for any. For scientific papers *ex-post* (the most common method in this review), sub-sampling could be used, but with the caveat that the created sub-samples are challenging to apply to real-world clusters.

3.3 Different ways conjoint researchers have asked people to evaluate products -likability, preference, purchase intent and choice

Conjoint analysis can be conducted based on input questions, not just choice. These input questions were quite different among the 72 viewed articles. Preference, choice, likability, purchase intent and willingness to pay for different products have all been used in different papers. The author looked at how participants had to evaluate products in the 72 conjoint papers reviewed here. Fifteen articles used conjoint that was based on the preference of products (Annunziata & Vecchio, 2013; Hersleth et al., 2011; Kildegaard et al., 2011). For the complete list, see Appendix A); 21 articles asked consumers about their purchase intent towards products (D. Asioli, Næs, Øvrum, & Almlie, 2016; Charette et al., 2015; Le Roux et al., 2016; Lee et al., 2015; van der Zanden et al., 2015) for the complete list see appendix A). 6 articles asked product likability (Ares & Deliza, 2010; Endrizzi, Menichelli, Johansen, Olsen, & Næs, 2011; Endrizzi et al., 2015; Hersleth et al., 2011; Menichelli et al., 2012; Puyares et al., 2010). Purchase intent, preference and choice are the three predominant questions consumers ask, with 52 articles using one of these (Table 5).

No comparative studies were found where a previous study would have been repeated with the same orthogonal design features effect on different consumer behaviour (purchase likelihood instead of choice etc.) in mind.



Table 5. Basis for evaluating products in conjoint studies

Authors	Conjoint input	Nr of instances used
Multiple authors	Purchase intent	21
Multiple authors	Choice	16
Multiple authors	Preference	15
Multiple authors	Likability	6
Multiple authors	Willingness to pay	4
Multiple authors	Perceived healthiness	3
(Piqueras-Fiszman et al., 2013)	Attention	1
(Tempesta et al., 2010)	Quality perception	1
(Moskowitz et al., 2005)	Craving for the product	1
Shan et al. 2017	Perceived taste	1
Pentus et al. 2014	Positive emotion	1
Szymkowiak et al 2020	Previous purchase recall	1

Source: Developed by author

This could be done in the future. There were, however, papers that included multiple approaches but usually did not use the same underlying orthogonal designs and did not compare the results.

Choice, ranking, liking, willingness to pay and purchase intent are all different ways of evaluating products. There are multiple different combinations of what the task for the study participant and the behaviour type it was based on (see Table 6). This should get more attention in future research and comparison of questions could be conducted.

Table 6. Overview of the different conjoint tasks and what they could be based on.

Main task	Based on test subjects:				
Choose	Choice	Purchase intent	Likability	Willingness to pay	Preference
Order	Choice	Purchase intent	Likability	Willingness to pay	Preference
Rank	Choice	Purchase intent	Likability	Willingness to pay	Preference

Source: Developed by author

The product attribute combinations must be ranked or scored by the test subject. These scores or rankings can be based on different consumer behaviour questions. From the more unusual conjoint-based articles, Piqueras-Fiszman and colleagues (Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013) used eye-tracking with their paper focused on attention based conjoint. Ares and colleagues (Ares et al., 2009) asked about perceived healthiness, Tempesta et al. (Tempesta et al., 2010) asked about quality perception and Moskowitz (Moskowitz, Silcher, Beckley, Minkus-McKenna, & Mascuch, 2005) asked craving for the product. Even facial expressions-based emotions have been used as input for conjoint (Pentus, Mehine, & Kuusik, 2014).



There are interesting outtakes on how this very fact influences results if people evaluate products in the context of purchase intent ((de Andrade et al., 2016; Font et al., 2011; Jansen et al., 2015; Kimura et al., 2012; Le Roux et al., 2016) or preference (Annunziata & Vecchio, 2013; Baumgartner & Steiner, 2007; Bernabéu et al., 2013; O'Connor, Cowan, Williams, O'Connell, & Boland, 2006). Price has shown to be less relevant and with a lower utility if the preference is asked. However, price is more relevant when purchase intent is asked instead. An intuitive result but brings caution when choosing what to ask conjoint study participants to do. There are multiple ways to ask people to rate or rank different conjoint products, as seen in Table 6. Purchase intent, preference and choice are the most common ones. There is much versatility, which should motivate future research to use different approaches.

3.4 Product categories included in the research - hedonic vs utilitarian attributes

The product that is the basis of a conjoint analysis influences the results, while often, the results are taken as more generic and applicable to a broader range of products. The product category specifics, product involvement and purchase involvement all play a critical role in how people choose or rank products.

Most papers focused on hedonic products. Of the viewed articles, 62 looked at hedonic products (e.g. Endrizzi et al., 2015; Lee et al., 2015; Nguyen, Haider, Solgaard, Ravn-Jensen, & Roth, 2015). For the complete list, see Appendix A) which is just eight articles researching utilitarian products (Baumgartner & Steiner, 2007; Charette et al., 2015; Le Roux et al., 2016) for the complete list (Appendix A). This shows a need for more research, as most of the conjoint food product research is done on hedonic products. Utilitarian products are left aside, and they need to be researched more.

3.5 Product attributes included in conjoint research articles - extrinsic vs intrinsic

Even though numerous ways exist for different product features, such as in design, different pictorial and information elements can be used; conjoint analysis requires a fundamental distinction. Since consumers base their decisions on their perceptions of quality, it is important to separate these features into two distinct groups—intrinsic and extrinsic—based on the previous conjoint literature (Daniele Asioli et al., 2017; Enneking, Neumann, & Henneberg, 2007).

Intrinsic attributes are the sensory elements of a product, which have classically been defined as product attributes that cannot be changed in an experiment without also changing the actual tangible physical features (the very nature) of the product itself (Olson & Jacoby, 1972). Intrinsic attributes like taste, smell, texture and composition of a product are often used to explain what intrinsic attributes are, but they differ based on the product. In addition to intrinsic and extrinsic, there are also experiential attributes which fall somewhere in between intrinsic and extrinsic. Experiential attributes are sensory and affective attributes like colours or smileys (Joško Brakus, Schmitt, & Zhang, 2014) used to generate a specific effect. It should be noted that experiential attributes are not to be mistaken for experience attributes. Experience attributes need to be sensed,



while experiential attributes do not (Joško Brakus et al., 2014). While smell, taste and viscosity can be important when tasting wine, the texture and feel of the bottle can be the sensory attributes in store when one cannot just simply taste a product just as experience attributes the intrinsic attributes of a product need to be felt or sensed by consumer’s senses in order to be perceived and understood. Either smelled, touched or tasted, not just seen or heard. Hence intrinsic attributes are also called sensory or experience attributes (Joško Brakus et al., 2014; Marreiros & Ness, 2009). You cannot know the taste of a product unless you taste it.

Extrinsic attributes are seen as a separate part of the product, and they can be altered without changing the physical product features and nature (Olson & Jacoby, 1972). Extrinsic attributes are all the visual packaging elements and the product's appearance. There is a grey area in-between extrinsic and intrinsic attributes of food products, where the two overlap. Extrinsic attributes like product pictures can be visual cues of intrinsic attributes. Dietary information like sugar content, fat content or even the ingredients are not purely extrinsic attributes. They form intrinsic expectations for the product. In the same way, some intrinsic attributes are also extrinsic. This connection between intrinsic and extrinsic variables needs to be considered.

Asioli and colleagues (Daniele Asioli et al., 2017) have suggested that more thought should be put into combined economic and sensory experiments to provide more practical information for product development. Future research should consider the interactions between intrinsic and extrinsic attributes. Only 16 articles looked at intrinsic attributes, of which 14 used a combination of intrinsic and extrinsic attributes (Endrizzi et al., 2015; Piqueras-Fiszman & Jaeger, 2014). For the complete list, see Appendix A), and only three looked at intrinsic attributes (Endrizzi et al., 2015; Kälviäinen et al., 2003; Piqueras-Fiszman & Jaeger, 2014). Majority of conjoint analysis papers, 38 in our review, only focus on extrinsic product attributes, as 11 look at a combination of the intrinsic and extrinsic variables. This shows that less emphasis is put on intrinsic attributes, which should be researched further.

The 72 reviewed articles varied based on which attributes they encompassed in their conjoint studies. There were 215 unique product attributes, which the studies addressed. From these, the most used attributes are brought out in Table 7. Price, brand and region of origin (be it a country or a region within a country) are the most researched product attributes in conjoint studies. These are also all extrinsic attributes. From one side, these are the most researched attributes. However, this shows that these attributes have the most significant role and interest for the researchers. While not a direct conclusion can be made from these numbers, these are also the most important attributes for consumers.

Table 7. The number of articles using a specific attribute, and their allocation as extrinsic or intrinsic

Attribute	Instances used	Intrinsic or extrinsic
Price	38	Extrinsic
Origin	19	Extrinsic
Brand	16	Extrinsic
Base product	9	Intrinsic



Nutrition	9	Intrinsic
Fat content	8	Intrinsic
Colour	6	Extrinsic
Health claims	6	Intrinsic
Taste	5	Intrinsic
Name	5	Extrinsic
Sugar content	4	Intrinsic
Sweetness	4	Intrinsic
Fibre	3	Extrinsic
Texture	2	Intrinsic
Seasoning	2	Intrinsic
Richness	2	Intrinsic
Caloric content	2	Intrinsic
Antioxidants	2	Extrinsic
Image	2	Intrinsic
Salt	2	Intrinsic

Source: developed by author

While there are papers that look at extrinsic product research papers (Claret et al., 2012; Kildegaard, Olsen, Gabrielsen, Møller, & Thybo, 2011; Le Roux, Bobrie, & Thébault, 2016), there are two papers that look at package design intrinsic variables like texture (Kälviäinen, Roininen, & Tuorila, 2003; Piqueras-Fiszman & Jaeger, 2014) or physical feel. The papers' most used intrinsic attributes included taste, sugar content/sweetness, texture, richness and fibre. The articles that combined intrinsic and extrinsic attributes did so in two separate studies. None of the articles included conjoint studies where intrinsic and extrinsic variables would have been part of the same orthogonal design. Future studies could be done with orthogonal designs where extrinsic cues are combined with intrinsic cues such.

3.6 The most important steps and questions that need to be answered before conducting a conjoint study

Sample size, and subsampling method, base product type (hedonic/utilitarian), attribute types and several levels, and base evaluation questions of conjoint and sample characteristics are all important elements in the flow of conjoint research. With a sound, well-explained logic of addressing these aspects, conjoint research can be an even greater tool for science and practitioners and be better understood. If these steps are thought through, and the decisions are calculated, the choices can be easily explained (Figure 3). The flowchart is similar to (North & Vos, 2002), who also addressed a conjoint research planning process, but only from the attributes choice side. So this flowchart has a broader view of the stages of planning conjoint analysis based on the approaches used by the reviewed 72 articles.

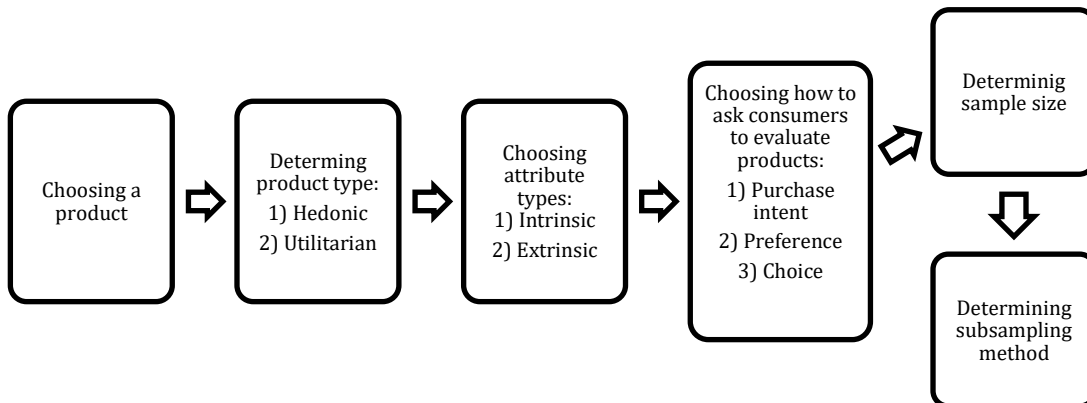


Figure 3. Flowchart of steps to take when planning to conduct conjoint analysis based on (North & Vos, 2002) and the research flow of the reviewed 72 articles

Source: developed by the author based on North & Vos, 2002)

When the steps from the model (figure 4) are addressed, and the argumentation is offered for the choice of product, its type, choice of attributes and the attribute types and levels, base question and the consumer behaviour underlying the answers and subsampling methods, then it will be easier to understand the reasoning why specific research was conducted, to compare and replicate. The author highlights topics needing more current knowledge from the review of these 72 food product conjoint analyses. These would be as follows:

- 1) The systematic difference (or similarity) of the relative importance of attributes when different base questions of evaluating products are asked. For instance, how different is the importance of price, origin or brand when the same people are asked to state their preference compared to when their purchase intent is asked;
- 2) There needs to be more utilitarian food product conjoint research. Products like vitamins, protein shakes and other food supplements could have different results compared to hedonic products;
- 3) More research is needed about the effects of intrinsic variables.
- 4) For the same reasons previously emphasised, the conjoint analysis could be done where intrinsic and extrinsic attributes are combined within the same orthogonal design. Though the testing would be unusual and more complex, the results could highlight the interconnected effects of intrinsic and extrinsic attributes;
- 5) The result's sensitivity to different *ex-post* subsampling methods could be analysed. Cluster analysis, while an invaluable tool to bring out within sample groups, is known to almost always give some results. A systematic analysis of the differences in results for the same sample should be done where multiple *ex-post* subsampling techniques are used and compared.



- 6) When *ex-ante* subsampling should derive from previous findings and consumer behaviour models, a broad *ex-ante* subsampling questionnaire could be created, which previous food science conjoint analysis papers used as a basis.

DISCUSSION

A significant number of articles have been written that use conjoint research methods. A substantial number of those have been published in the food sciences and product development. The food science articles, in general, have been reviewed by (Feldmann & Hamm, 2015) and product development science articles by (Vieira et al., 2015), but not with a focus on conjoint analysis. With this said, attempts have yet to be made to review conjoint analysis-based food product research. This was the aim of the current paper – to review food product conjoint analysis papers. Seventy-two articles were reviewed from 2000 to 2020 that used the conjoint analysis research method to understand better how it has been used in food product research.

As a result, it was determined that the average sample size for food product conjoint analysis is 459, with the median being 298. The notion is that half of the reviewed 72 articles had a sample below 298, with only a third of the papers with a sample bigger than 500. Over half of the papers used some kind of subsampling method. Twenty-three articles used post-hoc subsampling methods, with clustering being the most used approach, and eight papers used *ex-ante* subsampling. Common among the papers that have done some subsampling is that they always find and bring out subsamples with different results. This could be a sign that every sample, either small or big, has some kind of heterogeneity, indicating that authors conducting conjoint research should consider some subsampling method. Multiple different variations to how people had to rank or order conjoint cards were evident. Authors asked consumers their choice, purchase intent, preference, likability and willingness to pay as examples of used questions.

Of the reviewed papers, 62 look research hedonic products, and 38 only look at extrinsic attributes. On one side, it shows an apparent lack of research results, an understanding of utilitarian products, and how consumers prefer their attributes. At least when looking from the conjoint analysis perspective. Also, there needs to be more research done on intrinsic attributes. Price, brand and origins are the most researched attributes, with fat content, taste, colour, and the name being looked at in multiple papers.

A flowchart was given with the main steps and questions that must be addressed in the conjoint research. These choices need to be made, but they also need to be justified and grounded in previous work and theory or the absence of it. Stemming from the review, this research flowchart is a summarising guideline on how conjoint analysis could be conducted in a well-thought-through way.

This research flow can also be applied when companies apply conjoint research. The flowchart should be beneficial in raising the scientific level of practical applied conjoint research. Furthermore, the literature review side of this paper shows the versatile facets of food products conjoint research.



Central to this discussion is the value of conjoint research in the research sphere of food product and package design. With the nuanced insights from conjoint studies, businesses can navigate product and package design with greater precision, understanding the multidimensional preferences of consumers. By examining its application over two decades, this review contributes to refining its application, proving it as a valuable tool for future food product research.

CONCLUSIONS

This article explains what has previously been done in food product research with the conjoint analysis method. The research showed the average sample size and how heterogeneity has been addressed. With so little research on intrinsic attributes and combining them with extrinsic variables, understanding consumers' product evaluation process is insufficient. Also, the previous understandings from the conjoint analysis are predominantly hedonic products based, making it difficult to conclude about utilitarian products. Utilitarian products and intrinsic variables should get more attention in the future.

Sample heterogeneity can be a problem that should be addressed. Applying ex-post sampling can show sample structure and subsamples which are not actionable. Also, ex-post subsampling methods are not readily applicable to practitioners, and the results are complicated to repeat by researchers. Ex-ante subsampling should be considered and applied more often. The best solution to make the subsamples actionable and reproducible would be to use only ex-ante or a combination of both ex-ante and ex-post methods. Doing this so that the resulting subsamples would yield relevant and replicable results.

In conclusion, this systematic review illuminates the state of conjoint analysis in food product research today, providing critical information on sample sizes, heterogeneity, evaluation strategies, and the emphasis on hedonic goods and extrinsic features. The results highlight the necessity for an in-depth investigation into utilitarian goods' inherent qualities to improve our comprehension of consumer evaluation procedures. Future research should also justify their choice of evaluation methods and consider using ex-ante subsampling approaches or a combination of ex-ante and ex-post procedures to provide replicable and actionable results. This thorough evaluation presents a useful paradigm that businesses can use in addition to serving as a helpful resource for scholars exploring conjoint analysis in the context of food products.

Conjoint research has cemented itself as a high-value tool in the domain of food product and package design research. This review fortifies the methodological foundation for conjoint analysis continued application. The insights drawn from the review not only spotlight its importance but actively contribute to enhancing the method's application. It is evident that conjoint analysis will remain a crucial tool, ensuring it continues to provide deep, actionable insights for food product and package design research.

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Appendix A: List of reviewed articles

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