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Assessing the Effects of Abstract Attributes and Brand Familiarity In Conjoint Choice Experiments

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Abstract

The conjoint choice framework is extended to include effects of abstract brand attributes and brand familiarity. The proposed CONFOLD model describes consumers utility for the alternatives in conjoint choice experiments as a weighted sum of two components: one pertaining to the concrete attributes used in the design of the choice alternatives, and the other pertaining to abstract attributes underlying the evaluation of brand names. The weights of both of these components depend on the familiarity of consumers with each brand. An illustrative application to a conjoint study of automobiles is provided, which demonstrates that the importances of both concrete and abstract attributes increases with increasing brand familiarity.

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1. Introduction

Consumers are considered to arrive at product choices by utility maximization. The utility attached to a product or service is derived from its attributes. When faced with a choice decision, consumers use information on the attributes of the alternatives to determine utilities for the alternatives. Attribute information may be retrieved from memory and/or may be derived from the choice situation (e.g. Hastie and Park 1986). Prior to the choice, a consumer may have been exposed to information on some of the brands in question, through previous purchase and use, word of mouth, or advertising (Alba and Hutchinson 1987), leading to information about brand attributes being stored in memory. Abstract brand attributes are accessible in memory, and form the basis of brand attitudes (Keller 1993). When consumers are more familiar with the brands in question, the quantity of such accessible information in memory is higher. Hence, at higher levels of familiarity the amount of information that is retrieved from memory on abstract attributes may be larger (Alba and Hutchinson 1987, p.437, p.416; Bettman and Park 1980; Sujun 1985). In addition to the information retrieved from memory during the choice process, information on attributes is often available from the choice situation. Hence, if a consumer is unfamiliar with a product or service, s/he will tend to evaluate the product on the basis of the concrete attributes that are directly perceptible when a choice decision is made (Park and Lessig 1981, Rao and Monroe 1988).

Conjoint analysis typically deals with concrete attributes: abstract attributes often pose operationalisation problems in conjoint research (Louvière 1988, p.52). - Abstract attributes are important determinants of brand equity (Keller 1993), and are of preeminent importance in brand positioning (Aaker 1991, p.110-118). Several authors have used conjoint analysis to assess brand equity (Louvière and Johnson 1988, Rangaswamy, Burke and Oliva 1993, Swait et al. 1993, Kamakura and Russell 1993). In these studies, it is assumed that the utility of the profiles is derived from both the attributes, and the brand names included in the design. These approaches, however, neither identify abstract attributes affecting the brand's equity, nor the effects of brand familiarity.

The purpose of the current study is to develop a methodology that incorporates the effects of abstract attributes and brand familiarity into the analysis of conjoint choice experiments (cf. Louvière 1988, Louvière and Woodworth 1983). Recently, Chintagunta (1994) developed a model to estimate latent segments and underlying product dimensions from scanner panel data. Our model is related to Chintagunta's model but is estimated from conjoint choice data, rather than scanner panel data, and uses an ideal-point model rather than a vector model. More importantly, however, we incorporate the effect of brand familiarity, which is assumed to affect the relative importances of concrete and abstract attributes. Recently, the effects of familiarity have been included in multidimensional scaling and additive-tree modelling (DeSarbo, Chatterjee and Kim 1994, Chatterjee and DeSarbo 1992). These models provide spatial and tree- representations of paired comparisons data, respectively, rather than the choice data used for our model, and do not deal with the effects of concrete brand attributes. Our model is called CONFOLD and is described in the next section. We present an illustrative application, in which the model is estimated for a part of the automobile market in the Netherlands, and the effects of familiarity are demonstrated.

2. The model

To establish the notation, let

- i = 1, ..., n indicate consumers,
- j = 1, ..., J indicate choice sets,
- k = 1, ..., K indicate brands,
- l = 1, ..., L indicate choice alternatives,
- p = 1, ..., P indicate concrete attributes,
- s = 1, ..., S indicate segments,
- t = 1, ..., T indicate abstract attributes.

Let a conjoint choice experiment have been conducted, including K brand names and P concrete attributes. For ease of exposition -but without loss of generality- we assume each attribute to be at two levels. Let these concrete attributes be represented by P attribute dummies, X_{ip} . Using a fractional factorial design, the brand names and attributes are combined into L choice alternatives. A balanced

incomplete block design is used to arrive at J choice sets, which are offered to a sample of n consumers. Let each choice set j , include profile L as the base alternative. Each consumer i is required to choose one and only one alternative from each choice set C_j . Let $y_{ijl}^{(k)} = 1$, if consumer i chooses profile l containing brand k from choice set j, and $y_{ijl}^{(k)} = 0$ if not. The consumers familiarity with the set of brands, f_{ik} , is measured on an interval scale, having end-points 0 and 1.

It is assumed that the consumers are sampled from a population that consists of S unobserved segments, in proportions π_s , where $\sum \pi_s = 1$. Conditional upon being a member of segment s, the probability that consumers choose alternative l from C_j is derived from random utility theory as follows:

$$P_{jl|s}^{(k)} = \text{Prob} \{ U_{jl|s}^{(k)} > U_{jl'|s}^{(k')} \mid \forall l \wedge k \in C_j \}, \quad (1)$$

where $U_{jl|s}^{(k)}$ denotes the random utility of alternative l, containing brand name k, in set j. As usual $U_{jl|s}^{(k)} = V_{jl|s}^{(k)} + \epsilon_{jl|s}^{(k)}$. That is the utility is decomposed into a fixed, $V_{jl|s}^{(k)}$, and a random, $\epsilon_{jl|s}^{(k)}$, part. The key idea here is that the fixed part of this utility is modelled as a function of concrete attributes, abstract attributes, and brand familiarity:

$$V_{jl|s}^{(k)} = \exp(-\gamma f_{ik}) \left[\sum_{p=1}^P X_{jlp} \beta_p \right] - (1 - \exp(-\gamma f_{ik})) \left[\sum_{t=1}^T (c_{kt} - I_{st})^2 \right]. \quad (2)$$

Equation (2) describes the fixed part of utility as a weighted sum of the ‘‘conjoint part’’ involving the effects of the concrete attributes, represented by P dummy-variables X_{jlp} , and the ‘‘unfolding part’’, consisting of the contribution of the abstract attributes, represented by positions on T latent dimensions. Here, c_{kt} denotes the coordinate of brand k on dimension t. The weights of these components depends on the familiarity of consumer i with brand k, f_{ik} . I_{st} are the ideal point of consumers in segment s for dimension t, according to the simple unfolding model. Note that this ideal point is not specified for each consumer, but for each of a number of segments, which renders the model much more parsimonious. The parameter γ represents the familiarity effect. Observe that if a consumer is completely unfamiliar with a brand, then $f_{ik} = 0$, and equation (2) simplifies to:

$$V_{jl|s}^{(k)} = \sum_{p=1}^P X_{jlp} \beta_p \quad (3)$$

which is the aggregate multinomial logit conjoint choice model. This is consistent with the notion that if a consumer is completely unfamiliar with a product or service, s/he has no attributes in memory to retrieve and accordingly will use extrinsic cues to evaluate the product on the basis of concrete product attributes presented in the conjoint design. In the general case where γ and f_{ik} are nonzero finite, concrete and abstract attributes contribute to utility, with weights $\exp(f_{ik})$, and $\exp(-\gamma f_{ik})-1$, respectively. Thus, the model describes the situation that at lower levels of familiarity the quantity of memory-based information used in the choice process is smaller, and concrete attributes are used more relative to abstract attributes (Alba and Hutchinson 1987, p.437).

As usual, the error-part of utility is assumed to follow a Weibull distribution, which yields the following well-known equation for the choice probabilities, conditional upon knowing segment s to which subject i belongs:

$$P_{jl}^{(k)} = \sum_{s=1}^S \pi_s \frac{\exp(V_{jl|s}^{(k)})}{\sum_{l \in C_j} \exp(V_{jl|s}^{(k)})} \quad (4)$$

The model is estimated by maximizing the likelihood function over the parameters. For this purpose a quasi-Newton algorithm is employed. Starting values for the β parameters are obtained from a logistic regression of the attributes on choices. Starting values of the c - and I -parameters are obtained from the singular value decomposition of the segment by brand matrix of constants estimated using a latent class multinomial regression model (cf. Böckenholt and Böckenholt, 1991). This model was started with random values of the parameters. For each model, ten different starts were used in order to overcome problems of local optima. The starting value of $\gamma=1$ was used. It is well known that under certain regularity conditions, the ML estimates are asymptotically normal. In particular, the inverse of the matrix of the second order derivatives of the log-likelihood with respect to the

parameters provides the asymptotic standard errors of these parameters. In total there are $N=(S-1)+P+ST+TK-(T(T+1)/2)$ parameters to be estimated. For reasons of identification, $S \geq T$. The term $T(T+1)/2$ is subtracted because of rotational and centering invariance of the unfolding part of the model. The CONFOLD model is estimated conditional upon fixed values of T and S , Bozdogans (1994) CAIC statistic is used to determine the appropriate values.

3. The study design

Conjoint choice data for a part of the automobile market in the Netherlands were collected from 200 consumers who bought a new car within the last 5 years, using a mall-intercept sample. The category of automobiles was chosen because both concrete and abstract attributes, as well as brand familiarity were expected to play an important role. For the conjoint task 9 brand-types within a price range of Dfl. 25.000,- to Dfl. 35.000,-, were selected, because they were expected to be considered as alternatives by consumers. Consumers were asked to rate their familiarity with each of the 9 brands, on a 100-point scale, which was later rescaled to a scale with endpoints 0 and 1. The nine brand types were (average familiarity in parenthesis): (A) Renault 19 (0.578), (B) Alfa Romeo 33 (0.564), (C) Opel Vectra (0.771), (D) VW Golf (0.802), (E) Volvo 440 (0.709), (F) Daihatsu Applause (0.387), (G) Ford Escort (0.744), (H) Nissan Sunny (0.622), and (I) Kia Sephia SLX (0.132). After in-depth interviews with consumers and car-dealers the following 6 attributes (levels in brackets) were selected: (1) Price [Dfl. 27.000; Dfl. 30.000; Dfl. 33.000], (2) Mileage [5.3 l/100km, 6.3 l/100km; 7.7 l/100km], (3) Engine capacity [1.4 l., 1.6 l., 1.8 l.], (4) Power-steering [yes; no], (5) Number of doors [2/3, 4/5], (6) Airbag [yes/no] (1\$ is currently about Dfl. 1.60). Using the Addelman plans, a fractional factorial design was used to produce 18 alternatives. These alternatives were blocked into 9 choice sets of 3 alternatives each, to which the base-alternative "none of the profiles", was added.

4. Results

The CONFOLD model was estimated for several values of S . The number of latent dimensions, T , was taken equal to two for reasons of parsimony and interpretability of the plots. For all brand attributes, linear effects were estimated,

using effects-type coding of the corresponding dummies. The log-likelihoods and CAIC statistics were for S=2: $\ln-l = -2100.895$ (32 parameters), CAIC=4547.655; for S=3 $\ln-l = -2094.199$ (35 parameters) CAIC=4504.617; and for S=4: $\ln-l = -2092.968$ (38 parameters), CAIC=4561.446. The CAIC statistic reaches a minimum for S=3, reason for which we report that solution below.

For comparison, we also estimated an S=3 model in which the effects of familiarity were assumed to be absent and the concrete and abstract attributes both receive a weight equal to one (this model is the ideal-point version of Chintagunta's (1994) model for scanner data). The estimated brand coordinates and segment ideal-points for the two models without (Model 1) and with (Model 2) brand familiarity are shown in Figures 1 and 2, respectively. The estimates of the parameters of the concrete brand attributes and brand familiarity of the S=3 models are shown in Table 1.

[Insert Table 1 About Here]

For Model 1, Table 1 shows significant effects of mileage, engine capacity, the number of doors and the airbag. This sample of consumers prefer cars with higher mileage, higher capacity of the engine, 2/3 doors, and an airbag. The effect of price is not significant, although the estimate has the expected sign. Possibly, the range of prices offered in the study (Dfl 6000) was too small to demonstrate price effects. The spatial configuration of the brands shown in Figure 1 seems almost one-dimensional. On the horizontal axis, the most familiar brands (VW-Golf, Volvo 440, Opel Vectra) on the left are separated from the less familiar brands (Kia Sephia, Daihatsu Applause) on the right. The ideal points of all segments are closer to the familiar brands; that of Segment 1 (37.5%) being somewhat closer to Alfa and Opel than those of Segments 2 (30.2%) and 3 (32.3%). Thus, in the model that does not account for familiarity explicitly, brand familiarity comes up as the single major dimension.

[Insert Figures 1 and 2 About Here]

For Model 2, Table 1 shows significant effects of mileage, engine capacity and the number of doors. The consumers thus prefer cars with higher mileage, higher capacity of the engine, and 2/3 doors. Table 1 shows a highly significant effect of familiarity: the parameter is over 20 times its standard error. However, the familiarity parameter is negative, which was the case in various other

specifications of the model. The negativity of the familiarity parameter does not support the hypothesis that when brands are more familiar, a higher relative weight is placed upon the abstract brand attributes. Rather, the negative coefficient indicates that the concrete and abstract attributes both receive higher weight when the brand is more familiar. This can be seen by noting that the weight for the concrete attributes in equation (2) is $\exp[0.542 \cdot f_k]$, and that the weight for the abstract attributes is $(\exp[0.542 \cdot f_k]-1)$; these weights increase at an equal rate as a function of f_k because $\exp[0.542 \cdot f_k] \geq 1$ for all $f_k \in [0,1]$. Note however, that the model estimates retain the property that when brands are unfamiliar, only concrete attributes are used, since the weight for the abstract attributes is equal to zero when familiarity is zero. Since the weight of the unfolding part of the model is positive, the estimated ideal points estimated should be interpreted as anti-ideals. Anti-ideal points have been found in previous MDS studies and are very well interpretable (DeSarbo and Rao 1986): the choice probabilities are lowest at the ideal-points, and increase when moving away from the ideal. In Figure 2, the first dimension separates brand-types with a more sporty image (VW, Alfa and Renault) from the other brands, while the second dimension separates family type reliable cars (Volvo and Opel) from the other brands. From the ideal points we infer that Segment 1 (36.4%) has a preference for less sporty car-types, while Segment 3 (15.6%) prefers more sporty brands. The ideal- point of Segment 2 (48.0%) is located somewhat on the outside of the plot, indicating that this segment has higher purchase probabilities for all brands as compared to segments 1 and 3. This segment appears to have a somewhat higher preference for the family-type, reliable cars. Note that in Model 2, where familiarity is included, the familiarity dimension does not come up as a major abstract dimension, as was the case in Model 1.

In order to illustrate the moderating effect that brand familiarity has on brand attributes, we depict in Figure 3 the odds of consumer response to increases in mileage as a function of brand familiarity, i.e. $\exp(\hat{\beta}_2 \exp[-\hat{\gamma} f_k])$. For

convenience the effect was reexpressed as the sensitivity towards an decrease of 1 liter/ 100 kilometers. The Figure shows that the sensitivity of consumers towards higher mileage increases when a brand becomes more familiar. The brands with low

familiarity (Kia, Daihatsu) have the lowest sensitivity to increases in mileage, and more familiar brands (e.g. VW, Opel, Ford) have a higher sensitivity. Thus, it pays more for more familiar brand to increase mileage.

[Insert Figure 3 About Here]

5. Conclusions and Implications

In this paper we have shown that it is possible to identify abstract dimensions underlying consumer responses to brand names from conjoint choice experiments. The CONFOLD procedure bridges the currently existing gap between the major product positioning and new product development methodologies: multidimensional scaling and conjoint analysis. Thereby, CONFOLD integrates the direct (conjoint analysis) and indirect (multidimensional scaling) approaches to measuring brand equity (Keller 1993). Familiarity effects on the relative importance of concrete and abstract attributes were highly significant. The results showed that negligence to account for brand familiarity in the CONFOLD model, caused familiarity to come up as the major abstract dimension underlying brand evaluations, leading to potentially incorrect conclusions about familiarity as an abstract attribute in the evaluation of brands.

The empirical findings for the automobile market demonstrated a strong effect of brand familiarity on the relative importances of both concrete and abstract attributes. Brand familiarity increased the importances of both types of attributes. Prior theory (Alba and Hutchinson 1987, Bettman and Park 1980, Sujan 1985) predicted that abstract attributes would become more important at higher levels of familiarity, because information on such attributes is more accessible in memory when brands are more familiar. Our study demonstrates that at higher levels of familiarity the importance of concrete attributes increases as well. Park and Lessig (1981) and Rao and Monroe (1988) have shown, that low familiarity will result in the use of nonfunctional attributes, while at higher levels of familiarity functional attributes would increasingly be used. This corresponds to our empirical findings. The concrete attributes in our study represented such functional attributes. These functional attributes increase in importance with increasing familiarity. Johnson and Russo (1984) have demonstrated that at higher levels of familiarity consumers more easily learn new brand information. This could mean that at higher levels of

familiarity consumers better process the information on concrete attributes presented in the conjoint choice task. Additional research pertaining to other markets needs to be conducted to corroborate our findings. Future research could extend CONFOLD in various directions: the model could for example accommodate metric conjoint analysis, and it could be extended to accommodate simultaneous profiling of abstract attributes with direct attribute ratings to assist the interpretation of the revealed dimensions.

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Table 1.

Estimated S=3 CONFOLD Parameters

Attribute	Model 1:		Model 2:	
	Estimate	(SE)	Estimate	(SE)
Price	-0.0283	(.0439)	-0.0044	(.0374)
Mileage	0.1233**	(.0444)	0.0632*	(.0287)
Engine capacity	0.3067**	(.0435)	0.2005**	(.0289)
Power steering	0.0376	(.0384)	-0.0012	(.0309)
Doors	-0.2278**	(.0356)	-0.1944**	(.0235)
Airbag	0.0846*	(.0377)	0.0088	(.0230)
Familiarity	0.0000		-0.5423**	(.0244)

* p<0.05; ** p<0.01

Figure 1.
S=3, T=2, Model 1 CONFOLD solution

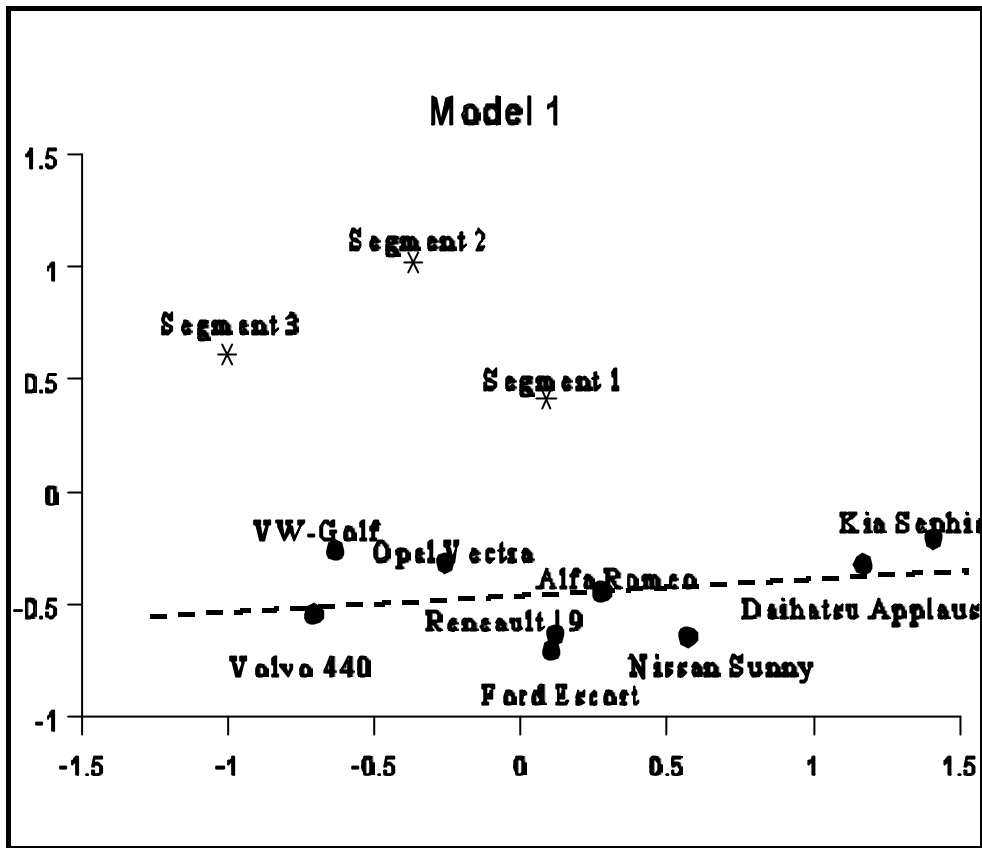


Figure 2.
S=3, T=2 Model 2 CONFOLD Solution

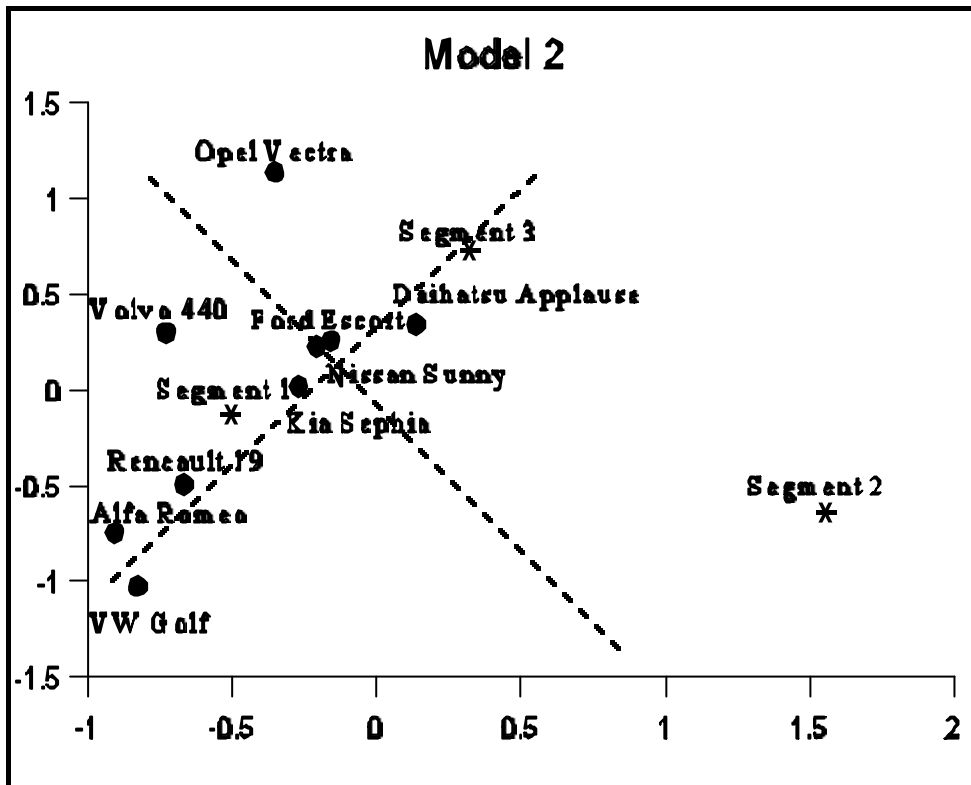


Figure 3.
Percentage change in the response probability for a one 1/100 km change in mileage

