Attitude-based models for binary choices

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Attitude-based models for binary choices: A test for choices involving an innovation

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Abstract

Several studies either implicitly or explicitly converted the well-known theory of reasoned action into a theory for choice. In this paper we elaborate upon such an attitude-based choice theory by proposing different model variants for binary choices. The models vary in two respects: (1) the level at which alternatives are compared (level of comparison), and (2) the way the comparison takes place at each of these levels in reaching a choice (comparison mechanism). Based on these dimensions 45 models were formulated that were examined empirically by logistic regression on choice probabilities. The data set consisted of measurements on 467 entrepreneurs for different financial services, one of which was an innovation. Of the different comparison mechanisms, subtraction, without explicitly incorporating the similarity of the choice alternatives, turned out to be the most adequate. For these models, equal weighting of the attitudinal components could not be rejected, which made it impossible to test at which level the alternatives were compared. Structural equation modeling of the same data shows that the equality of the weights for the attitudinal components can be explained by the affective component of attitude being a major predictor of choice. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

Recently attempts have been made to incorporate choice into the theory of reasoned action (Dabholkar, 1994). This can be seen as an integration of the theory of reasoned action and discrete choice modeling, which both have been employed extensively in marketing and consumer research to understand subjects' behavior. From the point of view of the theory of reasoned action, such an integration turns out to have practical significance. Incorporating choice into the theory of reasoned action implies that comparisons among competing alternatives have to be modeled. Operationalizations of these comparative models have been shown to lead to stronger relations among the constructs of the theory of reasoned action and also to a higher predictive power with respect to behavioral intentions (Laroche & Sadokierski, 1994; van den Putte, Hoogstraten & Meertens, 1996).

From the point of view of discrete choice modeling, incorporating variables from the theory of reasoned action may make the models more apt for complex decisions. One problem area is known as "taste heterogeneity" or individual differences in preferences (Ben-Akiva et al., 1997). In the theory of reasoned action this "taste" variability is incorporated by letting attitude, or more generally, attitudinal components be subject dependent. By including attitudinal variables into discrete choice models, we have a way of accommodating for "taste" differences. Furthermore, the theory of reasoned action assumes that social pressure as embodied in the subjective norm is one of the determinants of intention. Incorporating this variable into discrete choice models extends the model in that decisions may also be influenced by an important class of "externalities" (Ben-Akiva et al., 1997).

A first investigation into the mechanisms underlying choice that starts from an expectancy-value framework, has been provided by Dabholkar (1994). In the present study we will undertake a further investigation of this aspect of choice. We examine some other comparison processes, which are suggested by choice models as proposed in the domain of mathematical psychology. These models also consider the potential role of similarities between choice objects. Expectancy-value models can also be characterized by the level at which the comparison of attitudinal information across the alternatives take place. Dabholkar (1994) distinghuished several levels, three of which will be considered in the present study. In addition we will examine at each level of comparison whether the attitudinal elements differentially affect choice. In a study by Shimp and Kavas (1984) into consumers' use of coupons this aspect was also addressed. They found indications that attitudinal components have a different impact upon the attitude. Combining the different comparison mechanisms with different comparison levels leads to the formulation of different attitude-based choice models, each of which can be tested empirically.

The present study differs from previous studies in several respects. Firstly, in the present study new attitude-based choice models are proposed that have not yet been tested empirically. Secondly, previous studies on the comparison mechanism (Dabholkar, 1994) did not examine how well (stated) choice data could be described by different models of attitude, but focused more on describing the relations between the different constructs within the theory of reasoned action. We will focus on how well observed choices can be described by the determinants as specified by the theory of reasoned action, since we judge this to be most decisive in judging the value of the different models. In this way we integrate the theory of reasoned action and the discrete choice modeling approach. Thirdly, in previous studies (see e.g., Bagozzi, 1981; Dabholkar, 1994; Shimp & Kavas, 1984) no explicit comparative statistical tests between models were performed. Only goodness-of-fit indices were examined, which provide no solid basis for comparing models. In the present study we compare models on how well attitude (as modeled on the basis of beliefs and evaluations) and subjective norm explain choice. The statistical test and comparison of these models is performed by logistic regression.

The paper is organized as follows. We will first provide a short overview of the basic theory of reasoned action as proposed by Ajzen and Fishbein (1980). The extension to choice models involving a comparison between alternatives is introduced, followed by a systematic overview of the models that are variants of these choice models. Next, we introduce a data set which involves choices among financial services, one of which is an innovation. After presenting the methods of analyzing the different models, a critical comparison of the models for the data set is performed. We present an explanation of the outcome of this model comparison, and conclude with a discussion of the implications of the present study's findings.

2. Attitude-based models for binary choices

Based on the theory of reasoned action different models can be formulated that are able to describe choice. Before delineating these models, we will first shortly present the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), which is the basis for all models considered. This theory postulates behavioral intention (BI) as the most immediate determinant of behavior. The behavioral intention expresses the degree to which a person intends to perform a particular act, and is assumed to be determined by the attitude towards the behavior (AT) and the subjective norm (SN). The attitude reflects the global evaluation of the behavior, whereas the subjective norm reflects the degree to which one thinks relevant others expect one to perform a particular behavior. In formula, this can be expressed as

$$\mathrm{BI} = \gamma_1 \mathrm{AT} + \gamma_2 \mathrm{SN}, \tag{1}$$

where γ_1 and γ_2 are the weights reflecting the importance of the attitude and the subjective norm in determining the behavioral intention, respectively. As is well-known, both the attitude and the subjective norm construct can be decomposed. For the attitude the decomposition is into beliefs and evaluations and for the subjective norm the decomposition is into the motivation to comply with the relevant reference groups and the corresponding normative beliefs. We will shortly address the decomposition of the attitude into beliefs and evaluations. Let b_{iA} be the belief as regards object A along attribute i, let e_i be the evaluation of the attribute i, then according to the classical version of attitude theory, we have for the attitude towards A:

$$\mathrm{AT}_A = \sum_{i=1}^{I} b_{iA}\, e_i, \tag{2}$$

where the summation is across the I attributes.

Recently, different versions of the theory of reasoned action have been developed with interest focussed on choice. These theories require measuring attitude, subjective norm and behavioral intention in a relative way. For such operationalizations the relations between the constructs have been shown to increase (Laroche & Sadokierski, 1994; van den Putte et al., 1996). Let the attitude towards A when compared to the other alternatives in the choice set be denoted by RAT_A (relative attitude towards A). Similarly, let the subjective norm towards A, when compared to the other alternatives, be denoted by RSN_A (relative subjective norm towards A). We consider both constructs to determine choice. That is, the probability of choosing A is considered to be an increasing function of both RAT_A and RSN_A. This relationship might be modeled by logistic regression (Hosmer & Lemeshow, 1989).

We want to examine how the belief and evaluation information on the choice alternatives relates to the choices made by the subjects. This implies modeling RAT_A further in terms of beliefs and evaluations. In particular the following two aspects will be examined: (1) the level at which the attitudinal information is compared across alternatives, and (2) the mechanism used in comparing the alternatives. First, we will consider the *level of comparison*. The highest level of comparison is the global attitude level. Since our empirical test involves the choice among two alternatives, we will focus on models for choices among two alternatives. Let the function $F(X, Y)$ be the "comparison" function, which expresses how two alternatives are compared in making a choice. For alternatives A and B, we can express a comparison at the attitude level as follows:

$$\mathrm{RAT}_A = F(\mathrm{AT}_A,\ \mathrm{AT}_B). \tag{3}$$

F is increasing in AT_A and decreasing in AT_B. The attitude towards alternative B, AT_B, is defined in a similar way as the attitude towards alternative A (see Eq. (2)).

To elaborate further upon the level of comparison, we introduce a more "molecular" representation of attitude (Shimp & Kavas, 1984). It starts from bundles of beliefs. Beliefs in such a bundle more or less tap the same underlying construct. For instance, in the domain of food products, one might think of the attributes "fatness", "saltiness", "naturalness", and "amount of additives" which all relate to a component "healthiness" of the product. The value of a choice alternative on such a component can be obtained as a sum of belief-evaluation products, the summation being across all attributes belonging to this particular component. For alternative A and construct j, this is defined as

$$\mathrm{EVC}_{jA} = \sum_{i \in I_j} b_{iA}\, e_i, \tag{4}$$

where EVC_{jA} stands for the expectancy-value of alternative A along component j, and I_j is the set of indices for all attributes relating to component j. At the more molecular level, we assume that the EVCs are the basis of comparison. In formula, this is expressed as follows:

$$\mathrm{RAT}_A = \sum_{j=1}^{J} \beta_j\, F(\mathrm{EVC}_{jA},\ \mathrm{EVC}_{jB}). \tag{5}$$

As can be seen, the alternatives A and B are compared along the different EVCs, and each component j may obtain a different importance weight β_j in calculating the overall relative attitude. A third possibility is a comparison at an even more detailed level: the belief level. Each belief-evaluation product is assumed to be compared across the alternatives and to exert a separate influence on the relative attitude. In formula, we have

$$\mathrm{RAT}_A = \sum_{i=1}^{I} \beta_i F(b_{iA}\, e_i,\ b_{iB}\, e_i). \tag{6}$$

It should be noted that the level of comparison is related to the distinction of "alternative-based" versus "attribute-based" processing, a distinction which is frequently made in the decision literature (Bettman, Johnson & Payne, 1991). In the case of alternative-based processing, first each of the alternatives is evaluated, and then a comparison is made to reach a choice. This corresponds to the level of comparison as defined in Eq. (3). For attribute-based processing, the alternatives are compared on a dimensional basis or on the basis of more detailed attributes. These comparisons are subsequently integrated in order to reach a choice among the alternatives. This corresponds to the comparison levels as defined in Eqs. (5) and (6). The relative constructs at a particular level of comparison need not necessarily affect the relative attitude differentially. In case a test points out that no different beta-weights for the attitudinal components are needed, we can perform a more "pure" test as to whether the decision process is attribute-based or alternative-based. Both aspects will be examined in the sequel.

The *nature of the comparison process*, is a second dimension along which different models of relative attitude may vary. Anderson (1981) showed that subjects use operations such as addition (subtraction) or multiplication (division) to arrive at judgments or decisions. Empirical results suggest that the addition mode seems to be easier for subjects than the multiplying mode. However, these results are not based on choice contexts. This motivates exploring the nature of the comparison process that is involved in (binary) choices. In a simple proposal, the comparison function F maps the belief and evaluation information onto a dummy variable. More precisely, we may specify F as

$$F(X,Y) = \begin{cases} 1 & \text{iff } X > Y, \\ 0 & \text{iff } X = Y, \\ -1 & \text{iff } X < Y. \end{cases} \tag{7}$$

If the attitude (component) towards object A is larger than the attitude (component) towards B the relative attitude (component) becomes 1. If the attitude (component) towards A is smaller than the attitude (component) towards B, the relative attitude (component) becomes -1. Otherwise, the decision maker is indifferent between the choice alternatives as regards the attitude (component), which is indicated by a score of 0. This comparison process corresponds to deciding for each attitudinal component whether there is an advantage or a disadvantage for the alternative as compared to the other. If these decisions are aggregated, say across the EVCs, the choice process boils down to (weighted or unweighted) counting how many more advantages one alternative has vis-à-vis the other alternative.

In more complex proposals, one may assume that the magnitudes of attitudinal components play a role. That is, it matters how large an advantage or a disadvantage is. A simple model in this case is given by the difference function (cf. Dabholkar, 1994)

$$F(X, Y) = X - Y. \tag{8}$$

A study by Biehal and Chakravarti (1983) suggests that consumers compare products' prices by subtraction. In the psychological literature there are also indications that, when only two choice alternatives are involved, the choice process is based on utility differences between alternatives along each of a number of evaluative dimensions (Albert, Aschenbrenner & Schmalhofer, 1989; Böckenholt & Kroeger, 1993; Busemeyer & Townsend, 1993). These studies suggest that RAT_A should be defined by a difference function.

The last comparison process that we consider involves comparison by ratio (cf. Dabholkar, 1994). It has been suggested that comparison by ratio may occur in case there is only global information as regards the choice alternatives. When specific information is considered people may tend to compare by taking differences instead of ratios (Dabholkar, 1994). Since for our study the arguments X and Y of the function F may be negative, we propose to transform these arguments before division as follows:

$$F(X, Y) = e^X / e^Y - 1. \tag{9}$$

Note that 1 is subtracted from the ratio. This is to preserve the relation, also present in the other comparison mechanisms considered: indifference as expressed by the arguments X and Y yields a relative attitude equal to zero.

A number of discrete choice models assume that the similarity of two alternatives affects choice. Two alternatives that differ in the corresponding utilities, but that are very dissimilar will not elicit that many choices in favor of one of the alternatives as two alternatives differing to the same extent in their utilities but being very similar. This principle is in fact embodied in so-called moderate utility models (Halff, 1976). Several empirical studies have shown that particular instances of moderate utility models (Candel, 1997; De Soete & Carroll, 1983; De Soete, Carroll & DeSarbo, 1986; Tversky, 1972, 1979) provide an adequate description of binary choice data due to incorporating the dissimilarity between the choice alternatives. In line with these results we will incorporate a variable d_{AB} in our models, representing the dissimilarity between choice alternatives A and B. We will consider two special cases of the Minkowski metric (Sharma, 1996), which are commonly used as representations of the psychological distance between objects: the city-block metric (d^{CB}) and the Euclidean distance (d^{E}). Both distances provide ways to calculate a psychological distance based on the belief scores of the alternatives. More precisely, we define the following psychological distances between choice alternatives A and B: [1]

$$d_{AB}^{\mathrm{CB}} = \sum_{i=1}^{I} |b_{iA} - b_{iB}|, \tag{10}$$

$$d_{AB}^{\mathrm{E}} = \sqrt{\left(\sum_{i=1}^{I} (b_{iA} - b_{iB})^2\right)}. \tag{11}$$

The effect of the interobject dissimilarity on choice can be incorporated by specifying F in an appropriate way. We make three proposals. In each proposal RAT_A increases in d_{AB} if the relative attitude is in favor of B and decreases in d_{AB} if the relative attitude is in favor of A. This is in line with the influence of dissimilarity on choice as specified by moderate utility models. The three proposals are straightforward extensions of the specifications given in Eqs. (7)–(9). We extend F with one argument, Z, which stands for either the Euclidean or the City Block distance. The first one extends the function as defined in Eq. (7):

[1] Another possibility is to define the distances by weighting the belief differences by the absolute values of the corresponding evaluations. This would reflect differential weighting, in which more important attributes get a larger weight. Defining the distances in this way, did not yield results leading to different conclusions, and therefore are not reported.

$$F(X, Y; Z) = \begin{cases} 1/Z & \text{iff } X > Y, \\ 0 & \text{iff } X = Y, \\ -1/Z & \text{iff } X < Y. \end{cases} \tag{12}$$

The second and third one are also straightforward generalizations of the functions in Eqs. (8) and (9). They are as follows:

$$\begin{aligned} &F(X, Y; Z) = (X - Y)/Z, \text{ and} \\ &F(X, Y; Z) = (e^X/e^Y - 1)/Z. \end{aligned} \tag{13}$$

Note that in each proposal we adapt F in such a way that if X exceeds Y, the value for F will be lowered when the value for Z (>0) increases. For each of the proposals, this will imply that an increasing distance between the alternatives lowers the relative attitude towards the more attractive choice alternative.

To illustrate what sort of models result for the relative attitude when the different levels of the modeling dimensions are combined, we will present two cases. If the relative attitude towards A is based on an unequal weighting of EVC components (see Eq. (5)), the EVCs are compared by subtraction and the distance between the choice options plays a role (see Eq. (13)), we have the following expression:

$$\text{RAT}_A = \sum_{j=1}^{j} \beta_j \frac{(\text{EVC}_{jA} - \text{EVC}_{jB})}{d_{AB}}. \tag{14}$$

When the comparison is at the belief level for example (with unequal weights) (see Eq. (6)), and the comparison occurs by ratio (see Eq. (9)), we obtain the following expression:

$$\text{RAT}_A = \sum_{i=1}^{I} \beta_i \left(\frac{e^{b_{iA} \ e_i}}{e^{b_{iB} \ e_i}} - 1 \right). \tag{15}$$

Note that by also considering the influence of dissimilarity according to either the Euclidean or the City-block model, the number of comparison mechanisms examined adds up to nine. Combining the levels of the two modeling dimensions, thus results in 27 ($= 3$ levels of comparison $\times 9$ comparison mechanisms) models. Since we also want to examine whether separate weights are needed for the models at the EVC and the individual belief level of comparison, 18 ($= 2 \times 9$) additional models have to be considered. Consult Table 1 for an overview of the resulting research design. It should be noted that some of the models, although derived from different underlying

Table 1
Model chi-square values for the logistic regression on choice probabilities

Comparison mechanism	Level of comparison				
	Individual belief × evaluation		EVC		Global attitude
	Unequal weights	Equal weights	Unequal weights	Equal weights	
No distance					
Difference	505.61	491.49	496.81	491.49	491.49
Ratio	458.78	448.74	458.24	451.85	455.67
Dummy	502.76	490.87	481.92	475.89	475.44
Euclidean distance					
Difference	503.28	489.51	493.49	489.51	489.51
Ratio	458.31	448.65	458.22	450.70	455.67
Dummy	494.81	479.82	469.97	468.21	464.44
City block distance					
Difference	499.38	483.82	487.28	483.82	483.82
Ratio	457.72	448.67	458.21	449.20	455.67
Dummy	490.87	475.08	467.21	465.15	459.60

choice processes, formally are equivalent. One can easily check that whenever the comparison is modeled by the difference operation and there is no differential weighting of the attitudinal components, the models are identical. For the design in Table 1, this means that nine models are empirically indistinguishable. The other models are different. In the sequel we will describe how these models are compared empirically.

3. Method

3.1. Qualitative pre-study

Before constructing a questionnaire and administering it to a large sample, a qualitative pre-study was done. A total of 40 entrepreneurs of medium and large sized hog farms participated. Four group discussions were held regarding the use of risk management instruments when selling hogs. The group discussions took place in an informal atmosphere and lasted for about 2 hours, on average. From these discussions two alternatives emerged as the main trading options for the decision makers that we studied: selling hogs by buying so-called hedging services from futures exchanges or selling hogs on the cash market. The first option is a rather new and innovative tool for the entrepreneurs, and can shortly be denoted as selling by futures contracts. It involves fixing a price in advance that will be received when the hogs are sold after they have been raised from piglets to hogs. Since the price is fixed in advance, this transaction instrument eliminates cash price risk. The second option is the traditional way of trading the hogs: selling the hogs after they have been raised from piglets to hogs at a price that will only become evident at the moment of the actual transaction. It was also investigated what attributes or decision criteria entrepreneurs use in evaluating these choice options. This information was used to construct the belief measurements in the large scale survey. The beliefs relate to attributes that can be grouped into three categories: the ease of use of the financial service, its risk reducing capacity, and the degree to which it allows one to exercise one's entrepreneurial freedom. The appendix presents an overview of the attributes included in the questionnaire.

3.2. Sampling and administration procedure

The data of the survey were collected by means of computer-guided personal interviews among a representative sample of 467 respondents. Our subjects were entrepreneurs of small and medium sized hog farms in the Netherlands. Each interview lasted for about 45 minutes. In the questionnaire the entrepreneurs had to make judgments regarding two choice options: selling hogs by buying hedging services from futures exchanges or selling hogs on the cash market. These emerged as the main choice options from the qualitative pre-study. Obtained were belief statements, evaluative judgements, measures of the global attitude and the subjective norm, as well as stated choice in connection with these choice options.

To avoid response biases the statements concerning the two choice options were offered to the respondents in a randomized way. Moreover, the beliefs, evaluations, attitude, subjective norm and choice statements were given after having presented a particular choice scenario to the respondents. Answers were thus given for a more or less standardized situation.

3.3. Measures

The beliefs and evaluations were measured on 9-point bipolar scales. For beliefs the end-poles were labeled as "strongly disagree" and "strongly agree", whereas for the evaluations the end-poles were labeled as "very negative" and "very positive". Ryan and Bonfield (1975) and Wochnowski (1995) argue that, when multiplying beliefs and evaluations, only the use of bipolar scales will result in a logical pattern of attitudes. Moreover, several studies (Fishbein & Middlestadt, 1995; Sparks, Hedderley & Shepherd, 1991) indicate that bipolar scoring leads to the strongest correlations of attitude as a sum of belief-evaluation products and direct measurements of attitude. Therefore, in the present study bipolar scales were employed. [2]

The relative attitude and the relative subjective norm were measured by letting respondents distribute 100 points across the two alternatives. In the case of attitude the number of points expressed the extent of liking the alternatives. Given the formulation of this question ("Distribute 100 points according to how positive you feel about selling your hogs by futures contracts, when compared to selling your hogs on the cash market ?") this can be considered a measure of the affective component of the attitude. In the case of the subjective norm, the number of points given reflected the extent to which the entrepreneur thought that relevant others expect him/her to make use of one of the two alternatives. Finally, the respondent had to make a choice among the two choice options: selling the hogs on the futures market or selling the hogs on the cash market.

3.4. Preliminary analyses

An exploratory factor analysis of the belief-evaluation products was performed to find out what EVCs may be employed for the componential attitude models. Exploratory factor analysis suggested three components. These could be interpreted as entrepreneurship (to what degree does the transaction instrument allow the entrepreneur to exercise his/her entrepreneurial freedom), performance (how well does the transaction instrument reduce price risk) and ease of use (how convenient is the instrument to understand and apply). This three-dimensional structure was supported by confirmatory factor analysis. A LISREL analysis of the covariance matrix

[2] As noted by Bagozzi (1984), the (classical) expectancy-value model of attitude requires the belief and evaluation measurements to be of ratio scale level. However, a test of this model was devised (based on hierarchical regression), which allowed the measurements to be of interval scale level. The level of measurement required depends on the type of model considered. For the difference and dummy models multiplication with a positive constant is allowed for (ratio scales), whereas for the ratio model no transformation can be applied to the belief and evaluation measures (absolute scales). In case of the ratio model no test can be devised which allows for interval scaled measurements. Therefore, we will analyse the models assuming the level of measurement as required by these models.

was performed. Since the sample size was substantial ($N = 467$), a distribution-free test by generalized weighted least squares (Jöreskog & Sörbom, 1993) was done. This showed that the three factor model had an adequate fit. In the case of the hedging service we have a χ^2 of 57.75 (df = 24, $p < 0.001$), a root mean square error of approximation (RMSEA) of 0.055, a comparative fit index (CFI) of 0.92, and a Tucker–Lewis or nonnormed fit index (NNFI) of 0.88. For trading the hogs on the cash market the fit was also adequate, with a χ^2 of 27.58 (df = 24, $p = 0.278$), a RMSEA of 0.018, a CFI of 0.98, and a NNFI of 0.97.

3.5. Analysis methods

The different attitude-based choice models were compared with respect to how well they describe the choice data. The relative attitude calculated on the basis of belief-evaluation products according to one of the different models and the direct measure of the relative subjective norm were used as predictors of choice in a logistic regression (Hosmer & Lemeshow, 1989). This means that the probability of choosing alternative A, p_A, is modeled as

$$p_A = \frac{1}{1 + e^{-[\gamma_1 \mathrm{RAT}_A + \gamma_2 \mathrm{RSN}_A]}}. \tag{16}$$

Note that contrary to what is common in logistic regression, no intercept is included. The measurements for RAT_A and RSN_A in this study are such that when they both indicate indifference between the two choice options, they have the value 0. In this case we expect p_A to be one half. Including a nonzero constant in Eq. (16) would distort this relation.

Logistic regression estimates γ_1 and γ_2, such that the likelihood of the choice data given the model is maximized. We will provide as a measure of model fit the improvement of the -2 log likelihood as compared to the -2 log likelihood of the null model, which consists of only a (zero) intercept. This is called the model chi-square value. In comparing the different attitude-based choice models two principles are used: (1) models with an equal number of predictors can be compared directly in terms of their model chi-square values, and (2) nested models can be compared by testing the difference of their chi-square values with degrees of freedom given by the difference in the number of model parameters. The first principle applies to all models in Table 1 that are in the same column. These models assume the same level of comparison and thus result for logistic regressions with the same number of predictors. The second principle applies to testing whether there are equal weights for the attitudinal components. In that case we have a pair of strictly nested models. These principles turn out to be sufficient to make a selection among the different models.

For the optimal regression model, we also consider two goodness-of-fit statistics to examine the substantive significance of the variables in the model. We will consider Nagelkerke's R^2, which is similar to the R^2 in linear regression (Hair, Anderson, Tatham & Black, 1998), and the proportional reduction of prediction error (PRPE) (cf. Sharma, 1996). The latter statistic indicates the improvement in predictive power compared to a null model which does not include the predictor variables. [3] Let o_{m} be the observed proportion of correctly classified subjects according to the model and let e_{n} be the expected proportion of correctly classified subjects according to the null model, then the latter statistic can be expressed as

$$\mathrm{PRPE} = \frac{o_{\mathrm{m}} - e_{\mathrm{n}}}{1 - e_{\mathrm{n}}}, \qquad (17)$$

which is closer to 1 the more the model improves the null model in terms of predictive power. Note that the choice models are not compared on these goodness-of-fit statistics as these criteria are not optimized in model estimation, and comparing models on the basis of these statistics is not possible in an unambiguous way when models with different numbers of parameters are involved.

To obtain further insights into the results of the model comparison by logistic regression, a structural equation model will be tested. This model involves choice. Since choice is a categorical variable, biserial correlations are analyzed when choice is involved (Bollen, 1989). A biserial correlation can be considered a correlation for a variable underlying the observed choice variable, which is assumed to be standard normally distributed. Analyzing a mixture of biserial correlations (those involving the choice variable) and product moment correlations (the ones without the choice variable), requires using generalized weighted least squares as the estimation method (Bollen, 1989; Jöreskog & Sörbom, 1988). Since the number of observations is rather large ($N = 467$), we consider results significant whenever $p < 0.01$.

[3] Logistic regression allows for predicting choices. If the estimated $p_A \geqslant 0.5$, a subject is predicted to choose A, and otherwise is predicted to choose B. By combining these predictions with subjects' actual choices, the observed proportion of correct predictions can be calculated.

4. Results

4.1. Comparison of the models

The model chi-square values resulting from logistic regression are displayed in Table 1. Each model significantly improves the fit when compared to the null model, which includes only an intercept ($p < 0.001$). Furthermore, as is not shown in the table, none of the models can be rejected when compared to a saturated model which perfectly describes the data ($p \approx 1.0$). This indicates that the models considered describe the data sufficiently well. When we compare the models with a different weighting of the attitudinal components to the models with equal weights, in none of the cases the more complex model should be adapted. This is true for the comparison level corresponding to EVCs ($p \geqslant 0.02$), and for the comparison level corresponding to individual belief-evaluation products ($p \geqslant 0.05$).

Comparing the models within the same column of Table 1, which correspond to models with a different comparison mechanism but with the same level of comparison (assuming equal weights), we can conclude that the difference operation describes choice best. This is true for the models with a distance measure involved as well as for the models without a distance measure. Furthermore, incorporating the Euclidean distance nor the City Block distance improves the model's fit.

The models in the upper row of Table 1, with an equal weighting of the attitudinal components, are the optimal models. These models have the same model chi-square values. As already mentioned, this is because, although assuming that the comparison takes place at a different level, these models are formally equivalent. In each model the relative attitude is equal to the difference between the two choice alternatives of the sums of belief-evaluation products. Another noteworthy result is that the model starting from dummy comparisons at the belief-evaluation level does not perform much worse than the optimal model. This model corresponds to a choice process in which advantages and disadvantages are determined, which are summed subsequently to reach a decision. Finally, note that the optimal model is not only significantly better than the null model, but relative attitude and relative subjective norm also contribute substantively to explaining the choice data. Nagelkerke's R^2 was 0.79 and the PRPE was 0.84 pointing to substantive improvements of the null model.

As we have seen, the unweighted version of the difference model turns out to describe the choice data in the best way. Differential weighting of (groups of) belief-evaluation products does not significantly improve the prediction. In the sequel we test two hypotheses that explain these results. First of all, we hypothesize that for the present data the affective component of attitude is the best predictor of choice. Secondly, we hypothesize that this affect is best captured by an unweighted sum of belief-evaluation products.

4.2. An explanation by structural equation modeling

Not being strongly familiar with a product or service may result in global affect becoming a major determinant of choice. In our study the respondents were somewhat unfamiliar with one of the choice options: selling the hogs on the futures market. In such a case one may expect the affective component to play a predominant role in the choices of the entrepreneur. This may particularly be the case, since large consequences may result from the decision. The entrepreneur's decision may to a large extent determine the firm's financial performance and therefore the welfare of the entrepreneur's family.

To examine the hypothesis that affect is the major determinant of choice, we also obtained a direct measurement of the affective component of relative attitude by asking the respondents to distribute 100 points according to how positively they feel about using futures contracts as compared to trading on the cash market. Furthermore, we propose that the differences between the two alternatives on the three derived EVCs are also influenced by affect. One could argue that if a person feels that the hedging services provided by futures exchanges are a good thing, then this influences his or her evaluation of the hedging service on each of the three components. In a sense, we postulate the affective attitude to influence the cognitive measurements as embodied by the calculated EVCs as a kind of halo-effect. Although the three cognitive components in principle are almost unrelated, there are moderate correlations among the measurements of these components that reflect the affective attitude towards the trading alternatives. The degree to which the direct measurement of affect relates to the attitude construct underlying these three relative EVCs (REVCs) will support our interpretation as indicators of affect. We also want to test whether the attitude construct as measured in this study is unidimensional. The motivation is that two other studies (Bagozzi, 1981, 1982) showed that affective attitude as measured by bipolar scales like "good–bad", "pleasant–unpleasant" and "wise–foolish" can be represented by a unifactorial model. To support the interpretation of our measurements as indicators of affective attitude, we therefore also want to test whether they tap a single underlying construct. We can examine the issues addressed by testing the structural equations model as displayed in Fig. 1. If this test leads us to conclude that affect is measured, it makes sense to test whether the cognitive measurements are nonspecific reflections of this affect. Technically, we want to examine whether the REVCs have the same factor loadings on affective attitude. The equality of factor loadings implies – according to the regression method as well as the least-squares estimation method (Lawley & Maxwell, 1971) – that the scores on the affective factor will be equal to an unweighted sum of the scores on the REVCs. Thus, if we show that this affective factor is a major determinant of choice, we have provided an explanation as to why the unweighted sum of attitudinal components explains choice best.

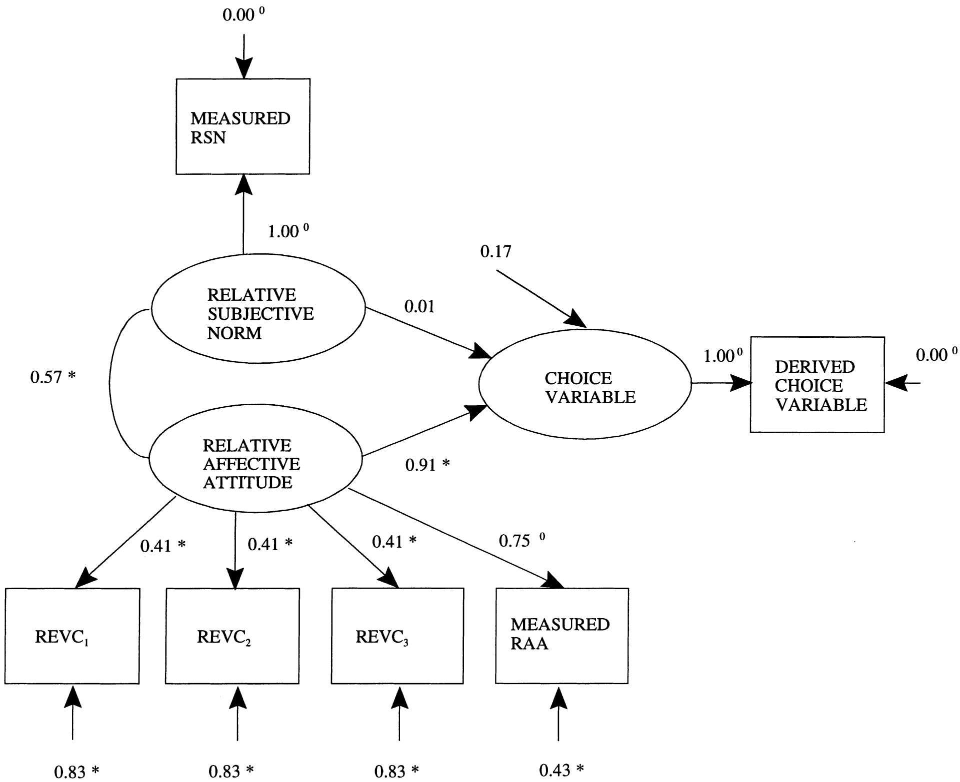

Fig. 1. A structural equation model in which the affective component turns out to be the most important determinant of choice, and the relative EVCs (REVCs) load equally on the affective component. Given is the standardized solution. Asterisk (*) means significant at $\alpha = 0.01$; superscript zero (0) denotes a fixed parameter in the unstandardized solution.

The fit of the model as depicted in Fig. 1, turned out to be very good: $\chi^2 = 10.23$ (df = 8, $p = 0.249$), RMSEA = 0.02, CFI = 0.99, and NNFI = 0.98. This supports the unidimensionality of the construct underlying the REVCs and the direct measurement of relative affective attitude. Also notice that the direct measurement of affect loads very strongly on this factor (viz. 0.75). These findings support our interpretation of the measured construct as affective attitude. The estimated model furthermore shows a high R-square for the regression on the variable underlying choice: 0.88. This supports our hypothesis that affect indeed is a very strong determinant of choice. The latter hypothesis is additionally supported by analyses with logistic regression. The direct measurement of relative attitude explains much more of subjects' choices in addition to the REVCs ($\Delta\chi^2 = 30.40$, df = 1, $p < 0.001$), than the REVCs add to the explanatory power of the relative attitude ($\Delta\chi^2 = 11.06$, df = 3, $p = 0.01$).

Finally, it was tested whether the factor loadings for the three REVCs in Fig. 1 are equally large. Constraining the three loadings to be equal, did not result in a significant deterioration of model fit: $\Delta\chi^2 = 2.52$ (df = 2, $p = 0.28$). Since the affective factor is a very strong determinant of choice, this may explain the success of the simple model, which departs from an unweighted sum of attitudinal components, in describing choice.

5. Conclusion and discussion

When comparing the attitude-based choice models that differ in the comparison mechanism underlying choice, the difference model without a distance measure turned out to describe the choice data best. For these difference models it was not possible to decide upon the level of comparison; the equal weight versions were superior, and for these versions, the models varying in the level of comparison are equivalent. For the other comparison mechanisms no consistent pattern emerges. The ratio comparison favors the alternative-based process, which may point to the aptness of the ratio model for comparisons at a more global level, that is, when only global information is used. The dummy comparison on the other hand, shows an advantage for the attribute-based process. This may be due to the increasing capability of this model to mimick the difference based choice model (which turns out to be optimal) the more molecular the comparison level becomes.

Several empirical studies (De Soete & Carroll, 1983; De Soete et al., 1986; Tversky, 1972, 1979) have shown that moderate utility models provide an adequate description of binary choice data by incorporating the dissimilarity between the choice alternatives. In the present study however, it was shown that incorporating the interobject similarity into the attitude-based choice models did not really improve the model fit. One reason for this could be that in our study respondents were presented with only one pair of choice alternatives. Effects of dissimilarity may especially occur when more alternatives are involved. When some objects are very similar and others are rather dissimilar, large variations in dissimilarity will occur which then will be necessary in adequately modeling choice. When only two alternatives are given, variation in dissimilarity only occurs due to differences between respondents and therefore may be rather small. Incorporating dissimilarity for these data may therefore not contribute to describing choice.

We could explain that an equal weighting of belief-evaluation products describes choice best, by assuming that affect is the strongest predictor of choice and a simple sum attitudinal components adequately taps this affect. The importance of affect is also evident from other studies. Abelson, Kinder, Peters and Fiske (1982) focused on the affective and cognitive components in perceptions of politicians. It was found that affect scores are highly predictive of overall politician evaluations, adding significant explanation over and above that due to cognitive components. Their results are explained by structural differences between affective response and belief judgements which may be traced to differences in the psychological perspectives associated with each. Affective responses concern the internal state of the responder, whereas belief judgements are focused on an external stimulus. One might say that belief judgements are "semantically filtered" to a greater extent than are affective responses, that is, considered more heavily in relation to an overall conception the respondent is attempting to convey. By contrast, affective responses are a more "naive," more direct reflection. Furthermore, affective measures differ from semantic or cognitive judgements in their function, particularly as motivators. Tomkins (1962) notes that affect is the "motor" for behavior. Because affective measures reflect motivation more directly than semantic judgements, they may surpass semantic judgements in the prediction of behavior.

In our study affect also seems to play a major role in the decision for buying the hedging service. This may be related to the novelty and innovative character of this financial service. The respondent did not have sufficient knowledge of the service's attributes and therefore may have based his or her choice mainly on the more global affect. The properties of services are said to be "intangible" (Lovelock, 1996), which makes it harder for the entrepreneur to evaluate the new choice alternative. The latter may also contribute to affect being the major determinant of choice.

The quality of the service not only depends on so-called search qualities (which can be determined before choosing) but also on experience and credence qualities (Lovelock, 1996). Lack of information with respect to the experience qualities may make affect an important determinant in making a decision among new services. Therefore it becomes crucial for new products and services, that not only information is provided on the attributes of the service or product, but that also a positive image should be provided to create a positive feeling.

In the present study, the importance of the choice ensured that the respondents were highly involved. Also, one of the choice alternatives was rather new. Other studies for different levels of involvement and familiarity with the choice alternatives should be held to examine the generalizability of the present results. We expect that in the case of familiar products and high involvement, cognitive elements (that is, beliefs on product attributes) will play a much larger role. In these cases it is possible that an attitude-based choice model departing from EVCs (with unequal weights) gives a much better description of the data. The distinction between products and services, and financial services in particular, then also will have to be examined further. Furthermore, the present study focused on choices among two choice alternatives. Developing attitude-based models for more than two choice options and critically testing these models for empirical data can be considered an interesting avenue for future research in the domain of choice modeling.

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Appendix A

The beliefs about futures contracts and trading on the cash market grouped according to the results of exploratory factor analysis

Entrepreneurship:

- I think that by using futures contracts/cash markets I can fully exploit my spirit of free enterprise.
- I think that the use of futures contracts/cash markets gives me the opportunity to obtain an extra high price.
- I think that using futures contracts/cash markets gives me a large freedom towards actions in the market place.

Performance:

- I think that selling my hogs by means of futures contracts/cash markets will enable me to reduce the fluctuations in my revenues.
- I think that a futures contract/trading in the cash market ensures the sales of my hogs.
- I think that using futures contracts/cash markets will improve my relations with traders.

Ease of use:

- I think that using futures contracts/cash markets is an easy way of selling hogs.
- I think that using futures/cash markets is a difficult matter.
- I think that by using futures/trading on the cash market I will not have to worry about finding buyers for my hogs.

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