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Scaling and Dimensionalizing Perceived Risk from Ratings Data: Managers' Risk Perception of Business Computers

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Abstract

A model for dimensionalizing and scaling perceived risk is presented. The scaling procedure provides risk values at the brand and category level on each of several risk dimensions. The model is illustrated with business managers' risk assessments of microcomputer profiles. The relative importance of various intrinsic and extrinsic cues in determining these perceptions was examined as part of the validation procedure for the several risk scales.

Perceived risk has been shown to be a significant construct in explaining consumer behavior and the importance of its investigation is well established (e.g., Engel, Blackwell and Miniard 1986; Sternthal and Craig 1982). This construct has been studied in relation to marketing issues such as mode of shopping, store selection, information seeking and information sources (e.g., Peter and Ryan 1976). It has also been suggested as one of the factors contributing to the slow penetration of new products into the market (e.g., Bearden and Shimp 1982). Due to the importance of clarifying the nature of perceived risk, the objective of the present paper is to introduce and illustrate a model for dimensionalizing and measuring this construct.

1. The scaling model

1.1. Background: perceived risk at the brand and category level

Early studies exploring the structure of perceived risk were conducted either at the brand or the product category level (e.g., Kaplan, Szybillo, and Jacoby 1974; Peter and Tarpey 1975). Peter and Ryan (1976) criticized previous research for lack of consistency in the levels of risk measurement (i.e., brand versus product category). (See also Ross 1975.) The distinction between risk at the brand and category level is generally accepted: Product categories are thought to be per-

ceived as inherently risky, while brands within categories may be perceived differently on the basis of specific information (Bettman 1973). This model, in fact, postulates that inherent product category risk serves as an anchor, while information regarding specific brands provides the basis for the adjustment of perceived risk for the various brands.

However, category risk, which is considered to be an anchor point for judgments at the brand level, has been neglected in most recent research. This is unfortunate since data on perceived risks at the category level could potentially provide important information for managers. In the early life cycle stages of innovative products, the objective may be to increase overall category growth. Pioneer, for example, competing in the category of high-quality stereo components in the United States, employed the strategy of promoting the whole product category (Takeuchi 1981). A second reason for investigating risk at the category level is theoretical. If indeed this construct is a factor in consumer risk perception, it should be included in empirical research. This would enhance the understanding of these processes and improve the testing of measures and theories.

1.2. Dimensionalizing perceived risk

The domain of perceived risk is typically captured by six risk components. These components were associated with two major dimensions in a study dealing with cars; The first dimension was associated with psychological and social risks and the second dimension with financial, performance, physical and time loss risks (Peter and Tarpey 1975). Our model below represents both product category risk components given by $\xi_i (i = 1, \cdots, 6)$ and brand risk for each dimension. We demonstrate below the existence of a single dimension of perceived risk for microcomputers, which is associated with two risk components, psychological risk (ξ_1) and social risk (ξ_2). A specific brand risk *on this dimension* resides at point η_j ($j = 1, \cdots, n$). The category risk components could be viewed as anchors around which there are brand risks for that dimension.

The difference between the brand and the category risk on the same dimension is thus $\eta_j - \xi_i$. The difference is hypothesized as driving the response of the ratings of the likelihood that a brand would evoke less/more of risk component i than the product category.

The model employed here to scale these data combines L. L. Thurstone's method of successive intervals (Toregerson 1958) with item response theory (Birnbaum 1968). If we assume a logistic distribution (over respondents) of the perception of a brand on a single risk dimension, then the probability of this brand being rated above boundary k (employing a rating scale with K boundaries) on risk component i can be shown to be:

$$\pi_{ijk} = \frac{\exp\{\kappa_{ij}(\eta_j - \xi_i) - \tau_{ik}\}}{1 + \exp\{\kappa_{ij}(\eta_j - \xi_i) - \tau_{ik}\}} \tag{1}$$

Where

η_{ij} is the perceived (mean) latent riskiness of brand j on a given risk dimension,
ξ_i is the product category's perceived latent risk for component i on the given risk dimension,
κ_{ij}^{-1} is the population standard deviation (about η_{ij}) of the logistic distribution for brand j when judged on component i,
τ_{ik} is a latent boundary k on the likelihood scale for component i.

Note that model (1) links observable likelihood proportions to brand and category risk on a specific dimension of perceived risk. Moreover, since the model can be rejected, it can *test* the scalability of several risk components on the same risk dimension. By carrying out this test over the hypothesized subsets of components we can dimensionalize perceived risk for a product category and simultaneously measure perceived brand and category risk.

2. The business microcomputer study

A practical question facing the marketing manager is how to reduce risk in order to facilitate product adoption. Lessons from early research attempting to answer this question indicate the importance of examing factors (e.g., product cues) that potentially could reduce risk directly with respect to risk perceptions (e.g., Zikmund and Scott 1973). The following are related hypotheses.

Intrinsic cues (i.e., physical product attributes) when presented, are hypothesized as having a greater impact on product evaluation than extrinsic cues (i.e., nonphysical attributes) (Olson 1977). In the context of risk perception, however, the role of intrinsic cues may not be so dominant. First, warranties and consumer service (extrinsic cues) are hypothesized as significantly influencing perceptions of financial, time and performance risks because they provide information directly related to these risks. Secondly, the promotion of innovative products based on new technologies frequently focuses on overall company image. The impact of this extrinsic cue on less sophisticated consumers, or consumers who have limited access to experts able to assess a product's intrinsic cues, is hypothesized to be considerable, especially on psychological and social risk. Thirdly, some empirical findings support the hypothesis that price (an extrinsic cue) affects risk perception (e.g., Engel and Blackwell 1982, p. 326). Finally, warranty (an extrinsic cue) is provided, in part, to reduce perceived risk (Shimp and Bearden 1982). In the microcomputer study here, these extrinsic cues were presented to potential buyers

along with three intrinsic cues. It was expected that the impact of these extrinsic cues on risk perception would be at least equal to that of the intrinsic cues.

2.1. Method

2.1.1. Overview. This study was carried out as part of the marketing activities of a company opening a new computer store in a sunbelt community. Prior to the opening of the store, about 450 businesses were sent a letter informing them of the opening. These small businesses were to be a primary market segment for the new store. The letter, which was on company stationery, also informed business owners that in the effort to serve their needs, the company was conducting a professional survey on microcomputers. Business owners interested in acquiring a computer were encouraged to participate in the study. In return, they were to be invited to an educational workshop ($30 value) to be conducted by the company. The letters were sent in three waves. After each wave, follow-up telephone calls were made to assess interest, answer questions, and schedule meetings to administer the experimental task. What was meant by business microcomputers was clarified to the respondents in the telephone calls and during the course of the interview. A pilot test was conducted with several managers to assess whether there were any problems with the interviewing procedure and the questionnaire. For the main study, 137 business owners expressed interest and completed the questionnaire in meetings conducted in their offices. It took about 25 minutes to complete the experimental task. This special procedure was thought to provide external validity to the study.

2.1.2. Design and procedure. A fractional factorial experimental design was used to examine the impact of product-related cues on risk perception of microcomputers. This new product category was assessed as being inherently interesting (e.g., Dickerson and Gentry 1983) and risky, thus suiting study objectives. The cues and their levels were selected on the basis of extensive discussions with managers, salespeople, and experts in the market. The experimental material was also carefully pretested with managers. Seven cues were used but only six were experimentally manipulated by means of a 3×2^5 fractional factorial design (Adelman 1962, Green 1974). The manipulated intrinsic cues were working space, expandability, and capacity. The extrinsic cues were price, service provided by the store, and the reputation of the manufacturer. The seventh cue, warranty, was identical for most manufacturers at the time of the study and was therefore presented identically on all 16 profiles.

Respondents were provided with 16 randomly ordered profiles. After examining each profile, respondents were asked to rate six risk components on the basis of the information presented in that specific profile, and to provide an overall evaluation of the computer described on a scale anchored by good-bad.

Risk components were operationalized in a manner similar to that used in previous research (e.g., Kaplan et al. 1974, Peter and Ryan 1976). Respondents were asked to indicate the likelihood of each risk component on a three-point scale. In contrast to previous research, respondents in this study were asked to compare the specific brand (profile) and the general product category. For example, "How likely is it that the microcomputer described above will cause you less financial loss than other business microcomputers (e.g., financial loss due to maintenance cost)." Three-point scales were used to simplify the task. This was done without comprising the scale procedure, since data consisting of three-point scales are sufficient for this scaling model to produce the continuous underlying latent continuum.

2.2. The dimensionality of perceived risk for microcomputers

The logit model in (1) was used to estimate the latent scale values for risk at both the brand and product category levels. As already indicated, this model also enables various structures of perceived risk to be tested. By testing the model in (1) with different risk components, a researcher can reject unacceptable structures. The estimation, which is carried out by a Generalized Least Squares (GLS) procedure, provides a chi-square test for the fit of the model. (For more details see Bechtel and Ofir 1988).

The risk components were generated on the basis of previous research (Peter and Tarpey 1975), which showed that the psychological and social risk components formed one dimension, whereas the four other components (i.e., financial loss, time loss, physical risk, and performance risk) formed a second dimension. The model employing the psycho-social risk components was accepted here on the basis of a $\chi^2_{47} = 41.8$. The model employing the remaining four risk components, however, was rejected. Therefore, the model was reestimated separately with all possible combinations of the latter four components. The only acceptable resolution was that obtained by splitting the four risk components into two separate risk dimensions containing two components each. The first estimation employed the physical and performance risks with a $\chi^2_{47} = 53.2$, and the second estimation employed the financial and time loss components resulting in a $\chi^2_{47} = 50.4$. In summary, three risk dimensions emerged; one associated with psychosocial risk, a second with performance and physical risk, and a third with financial and time risk.

2.3. Validating the three risk scales

2.3.1. Risks as dependent variables. The close fit of these models (by the chi-square tests above) suggests *internal* validity of the scale values on our three dimensions of perceived risk. These scale values were subsequently subjected to an *external*

Table 1. Relative importance of product cues determining risk

	Psycho-social risk	Performance-physical risk	Financial-time risk
Price	.045	.072	.072
Working Space	.137	.107	.064
Expandability	.184	.163	.102
Capacity	.208	.153	.103
Store Service	.189	.223	.488
Company	.237	.283	.172
Extrinsic Cues	.471	.578	.732
Intrinsic Cues	.529	.423	.262

fractional factorial analysis. This analysis provides an assessment of the relative importance of product cues for each of the risk dimensions.

The effects of the intrinsic and extrinsic cues on each of the three risk scales were examined by means of a linear model. The dependent variable for each model was the scale value representing risk on a specific dimension across sixteen brands. The design matrix corresponded to the underlying fractional factorial design was represented by dummy variables. Each model was estimated separately by OLS, which is used frequently in similar conjoint studies (e.g., Wittink and Cattin 1981).

The fits of these models in terms of R^2s are reasonably high, ranging from .92 to .97. The adjusted R^2s of the models are .94, .85, and .95, respectively. The combined results suggest that all of the models provide adequate fit and are acceptable. The estimates of each model are on the same interval scale. In order to ensure comparability across models, the relative range of each cue was normalized through comparison with the sum of the ranges in each model. These importance indicators, ranging between zero and one, are presented in the table.

In line with our hypothesis, it was found that extrinsic cues play an important role in determining perceptions on all three risk dimensions (see table). Specifically, they were influential in determining the risks of dimension 2 (i.e., performance and physical risks) .578, and of dimension 3 (i.e., financial and time risks) .732. Dimension 1 (i.e., psycho-social risks) is almost equally determined by intrinsic and extrinsic cues. A priori, company image was hypothesized to be a major factor in determining the psycho-social risk (i.e., dimension 1). The results, however, suggest that other cues have an impact as well, in particular the intrinsic cues working space .137, expandability .184, and capacity .208. These intrinsic cues, however, had less effect on the other two risk dimensions. On the financial-time risk dimension, their joint effect was only .262. Perceptions on this dimension were mainly influenced by store-service .488. It seems that a store that is able to provide a comprehensive technical service enjoys an advantage in terms of reducing the perceived risk associated with financial and time loss.

*2.3.2. **Risks as independent variables.*** A further validation of our three risk scales was obtained by examining the effects of risk perception on product evaluation by means of a regression analysis. Values for overall product evaluation were derived from a logistic scaling method which embraces model (1) as a special case (see Bechtel and Ofir 1988). These evaluations were then regressed against the three risk dimensions.

OLS estimation produced a model with an R^2 of .873. The estimated parameter which is associated with risk dimension 2 (i.e., performance and physical risks), however, was not significant. The model was reestimated without this variable, producing an R^2 of .870 and an adjusted R^2 of .850, which suggests a reasonable fit. The parameters associated with psychological-social risk and financial-time loss were respectively -0.53 ($p < .01$) and -0.46 ($p < .01$). The model was also compared to various polynomial models without any significant gains in fit (e.g., Cohen and Cohen 1975). Overall, these results provide additional construct validation of the risk scales produced by model (1).

3. Discussion

3.1. The effects of intrinsic and extrinsic cues on risk perceptions

The above results demonstrate that despite the presence of intrinsic cues, extrinsic cues have a substantial effect on perceived risk. The effects are obtained on all three risk dimensions, and on two of these dimensions the effects of extrinsic cues are higher than those of intrinsic cues. Specifically, company image has a substantial effect on all dimensions: .237, .283, and .172, respectively. The strategy used frequently in this market, i.e., of promoting overall company image, is justified according to these results. The ability of the store to provide comprehensive service is also an important factor in reducing perceived risk, particularly financial-time risk (an effect of .488). The fact that Apple computer dealers provided 90% of the diagnostic testing and repair work for their Apple II computer probably served to reduce consumers' perceived risk and facilitated market penetration (Gable, Tylka and Maidique 1984). Finally, price, an extrinsic cue hypothesized to increase perceived risk, has only a minor effect on all risk dimensions. In the presence of other product cues, the effect of price on perceived risk is apparently only marginal. This finding is reminiscent of studies on the price-quality relationship, which demonstrated that the effect of price on perception of quality may be reduced in the presence of other cues (e.g., Monroe and Petroshius 1981).

Overall, intrinsic cues have less effect than extrinsic cues, except for psycho-social risk, where the intrinsic effect is slightly higher. The intrinsic cues used in this study, particularly capacity, seem to have social significance and play an important role in reducing the psycho-social risk associated with microcomputers. It is very likely that these intrinsic cues, especially capacity, are a discussion topic

among owners of business computers and are therefore important. The cumulative results indicate that less sophisticated customers, when considering a technological innovation, rely on extrinsic cues.

3.2. The effects of perceived risks on product evaluation

Two risk dimensions, i.e., psycho-social and financial-time, had a significant effect on overall brand evaluation. The performance-physical risk was highly correlated with the financial-time dimension, which may explain the lack of any effect (e.g., Gunst and Mason 1980; Ofir and Khuri 1986). The three-dimensional risk representation is different from the two dimensional one obtained by Peter and Tarpey (1975). This difference may be due to the different product categories employed (cars vs. microcomputers). The effect of perceived risk on overall product evaluation is significant in that it supports the assumption that reducing perceived risk may facilitate product adoption by alleviating negative attitudes toward the brand.

4. Summary

A model for the scaling of perceived risk was introduced and illustrated. The application of the model in the context of microcomputers suggests that further research is needed to assess the structure of perceived risk in various product categories. A better understanding of risk perception will also facilitate research investigating the role of perceived risk in shaping consumer preferences and attitudes.

Note

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