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Extending Rungie et al.'s model of brand image stability to account for heterogeneity

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brand image stability, answer formats, questionnaire design, finite mixture models, unobserved heterogeneity

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Rungie et al. (2005) recently proposed a model that describes the reliability and stability of responses to attitude questions in brand image measurement. We test the validity of this model compared to the model proposed originally by Dall'Olmo Riley et al. (1997) using a new data set which was collected in view of findings by Dolnicar and Heindler (2004) that respondent fatigue has major negative effects on brand image stability. We propose an extension to the proposed model in which we account for heterogeneity in stability across brand-attribute associations. The extended model performs better than the two benchmark models and appears to discriminate well between stable and unstable brand-attribute associations.

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Track: Marketing Research and Research Methodology

Introduction

Brand image measurement has a long history in marketing and forms the basis of brand marketing activities. The assumption underlying any investment into brand marketing activities is that individuals form brand images largely on the basis of brand advertising and that these images are stable and do not change randomly. The latter assumption has been challenged by Dall'Olmo Riley, Ehrenberg, Castleberry, Barwise and Barnard (1997). Dall'Olmo Riley et al. claim that brand image stability is low and propose a model that describes the stability of brands in empirical data sets as depending on the response level:

$$RR = RL + 20\% \qquad \text{Model 1}$$

In this model RR stands for the repeat rate (the proportion of respondents who endorsed a brand-attribute association in the second wave of measurement among all respondents who endorsed this particular brand-attribute association in the first wave) and RL stands for the response level (the proportion of respondents who endorsed to a brand-attribute association in the first wave of measurement).

Recently, Rungie, Laurent, Dall'Olmo Riley, Morrison and Roy (2005) proposed an improved model:

$$RR = c + (1 - c)\, RL \qquad \text{Model 2}$$

The *coefficient c* in Model 2 is referred to as "reliability" by the authors, although *coefficient c* actually captures more than only the pure reliability of measurement: (1) actual attitudinal change, (2) instability due to attribute-brand associations which may not be relevant, and (3) instability in the measure itself, that is, of respondents' endorsements..

This paper has two aims. First, we will replicate the study conducted by Rungie et al. (2005) for a new data set and in doing so test the validity of Model 2 compared to Model 1. This data set was collected in a way to ensure that fatigue effects which have been shown to decrease brand image stability (Dolnicar and Heindler, 2004) do not occur and that the product category is relevant to the population under study. Second, we extend Model 2 to account for heterogeneity in brand-attribute associations, because we suspect that respondents probably do not believe that all attributes relevant for a product category are suitable to describe (or not describe) a brand.

Data and Methodology

Evaluations of 11 attributes for six fast food chain brands were collected from students in two waves, with a one-week interval between the two measurements. The product category of fast food brands was established as a relevant product category for the population of students in exploratory qualitative fieldwork, as were the brand names and attributes.

Two alternative answer formats were used: a six-point, no midpoint, multi-category answer format asking for levels of agreement and disagreement and a binary answer format asking only for agreement or disagreement. The total sample size was 106 students (55 completed the six-point answer format, 51 the binary answer format).

Because the RL and RR measures have so far only been used for binary data, it is necessary to define how those measures will be used in the multi-categorical data case before models can be fitted. For all our computations we split the responses to the six-point answer format in the middle and set the three answer categories indicating agreement equal to a single agreement value and the three answer categories indicating disagreement equal to a single disagreement value.

Results

Comparative validity of models

The validity of the two models proposed was tested by computing ordinary least squares regressions using ρ, the probability of two agreement answers in both waves, as the dependent variable and RL and RL^2 as independent variables. Model 1 implies the following relationship between ρ and the RL:

$$\rho = RL^2 + 20\%\ RL,$$

whereas it is according to Model 2 given by:

$$\rho = (1\text{-}c)\ RL^2 + c\ RL.$$

Figure 1 depicts the data and the fitted regressions for the two answer formats and the pooled data. Table 1 provides the comparative figures on the model fit.

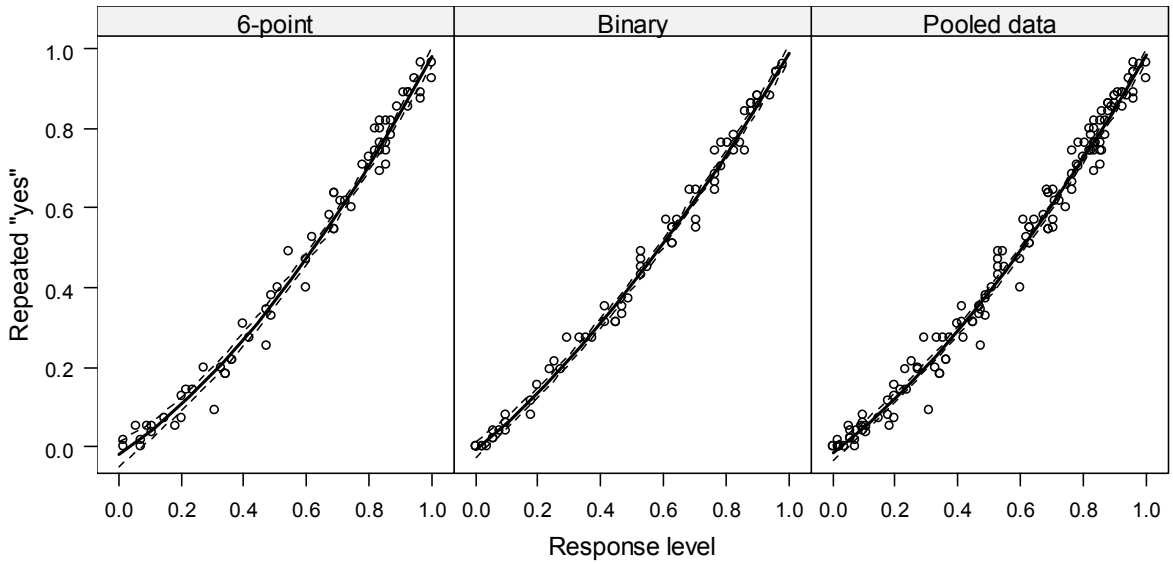

Figure 1. Empirical relationships between response levels and probability ρ of a repeated agreement answer.

The estimated regressions clearly support Model 2 and contradict Model 1. The coefficient of RL^2 deviates strongly from 1.0, ranging from .334 to .464. In addition none of the intercepts is significant at the .05 significance level. The sum of the coefficients of RL is close to 1.0 as predicted by Model 2. If the models are refitted without an intercept the sum of the coefficients of RL and RL^2 do not differ significantly from one using a *t*-test at a significance level of .05 (Six-point: t=1.040; Binary: t=0.782; Pooled data: t=1.383).

Table 1. Empirical ordinary least squares estimates of the regression of ρ on RL and RL^2.

Answer format	*N*	R^2	*F*	*Constant (t)*	*1st degree coef. (t)*	*2nd degree coef. (t)*	*Total*
6-point	66	0.985	2123	-0.020 (t=-1.274)	0.539 (t=7.630)	0.464 (t=7.022)	1.003
Binary	66	0.991	3303	-0.008 (t=-0.850)	0.663 (t=13.956)	0.334 (t=6.980)	0.998
Pooled data	**132**	**0.986**	**4396**	**-0.014 (t=-1.506)**	**0.608 (t=13.709)**	**0.390 (t=9.080)**	**0.999**

The linear relationships implied by Model 2 between the RR and the RL as well as the observed data are depicted in Figure 2. Clearly, RRs are higher than RLs generally. Equality of repeat rate with response level would be expected within Model 2 if respondents were answering randomly. An RR of 1.0 would indicate complete reliability.

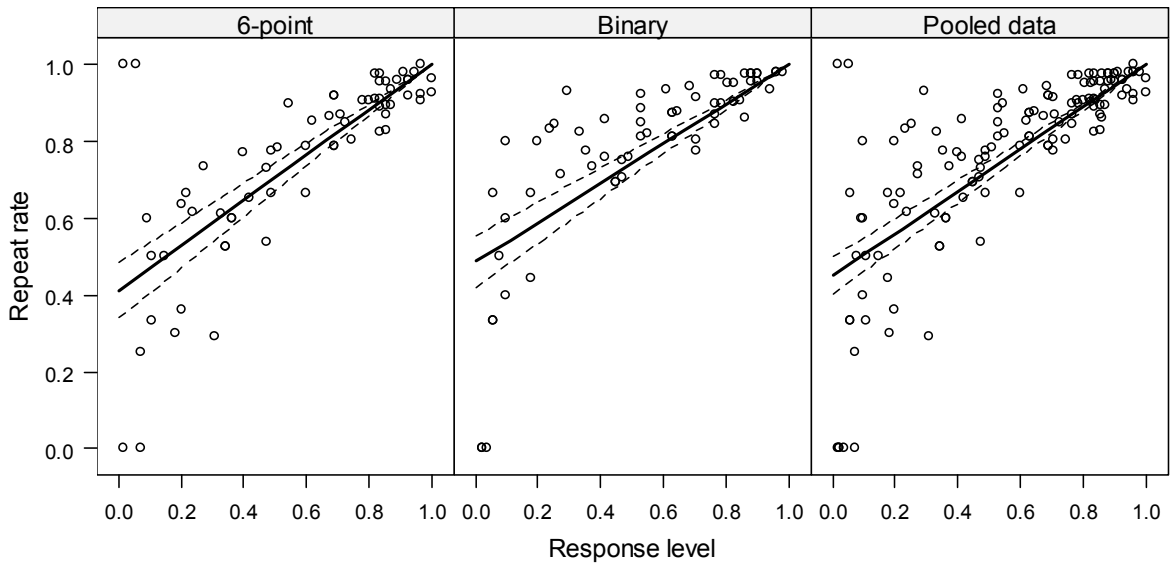

Figure 2. Repeat rate versus response level with the linear relationship implied by Model 2.

Essentially Figure 2 demonstrates that a single regression line – as postulated in Model 2 - does not fit the data very well, suggesting that the assumption of homogeneity of *coefficient c* is not supported. The hypothesis that *coefficient c* consists of multiple coefficients which describe subsets of brand-attribute associations (heterogeneity hypothesis of *coefficient c*) can be tested by fitting finite mixtures of regressions with two components. The components are restricted to having equal variances and to have at least a size containing 10% of the observations when fitted using the EM algorithm (Dempster, Laird and Rubin, 1977) to obtain the maximum likelihood estimates. When compared to the homogeneity model (Figure 2) the mixture model with two components (Figure 3) fits better with respect to the AIC and the BIC criteria.

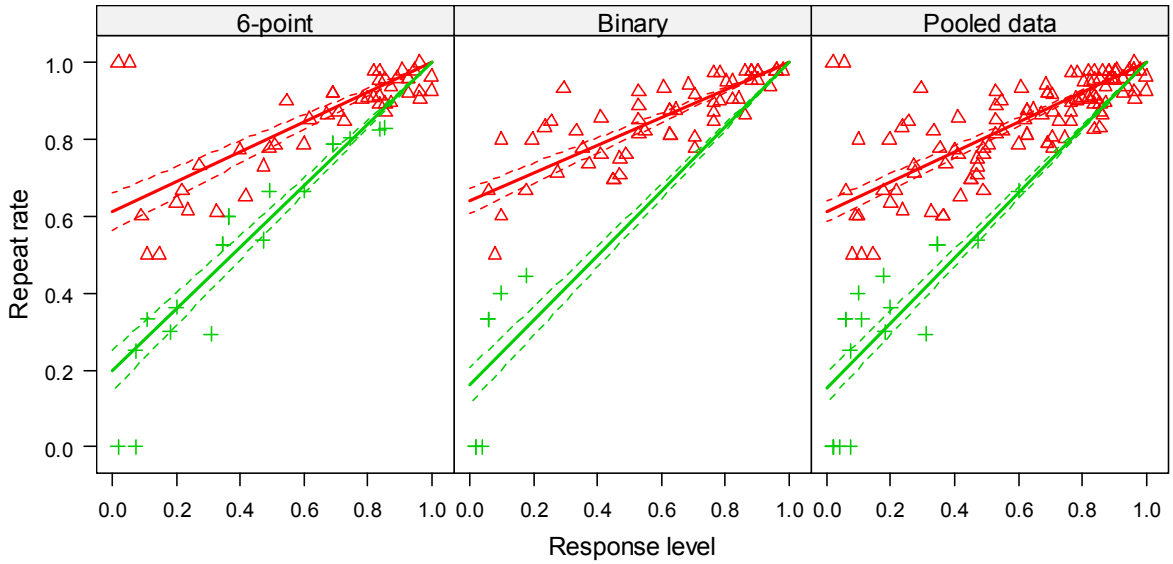

Figure 3. Repeat rate versus response level with the linear relationship implied by Model 2 allowing for heterogeneity of the reliability coefficients.

Figure 3 shows the fitted regression lines of the mixture models for each component. The observations are plotted in different colors according to the assignment to one of the two components with respect to their maximum a-posteriori probability. The estimated *coefficients c* and approximate standard errors as well as the relative size of the components are given in Table 2.

Table 2. Estimated *coefficients c* for each component of the mixture model and each answer format.

Answer format	*Component 1*			*Component 2*		
	Estimated coefficient c	*Standard error*	*Relative size*	*Estimated coefficient c*	*Standard error*	*Relative size*
6-point	0.481	0.017	0.737	0.345	0.047	0.263
Binary	0.661	0.016	0.803	0.214	0.026	0.197
Pooled data	**0.562**	**0.011**	**0.681**	**0.368**	**0.030**	**0.319**

These results indicate that splitting brand-attribute associations into more stable and less stable cases explains the data better than the originally proposed model which assumes homogeneity of brand-attribute associations. This is plausible as some brand-attribute associations (such as Subway and "healthy") are clearer in consumers' minds than others (such as Subway and "spicy"). Furthermore, the results in Table 2 show that the more stable (reliable) brand-attribute associations (those with a higher *coefficient c*) represent the larger of the two groups. For instance, in the binary case 80 percent of brand-attribute associations have a *coefficient c* of .661 and only 20 percent have the lower reliability coefficient of .214. We can therefore conclude that Rungie et al.'s Model 2 underestimates the reliability of brand-attribute associations.

Conclusions

Two alternative models describing the stability (reliability) of brand image associations have been proposed in the past. The aim of this paper was to assess which of the two models better describes a brand image data set that is not affected by respondent fatigue (Dolnicar and Heindler, 2004). The model proposed by Rungie at al. (2005) outperformed the model initially proposed by Dall Olmo Riley at al. (1997).

Further investigation of the model and visual inspection of model fit led to the hypothesis that the data could be better described if heterogeneity of brand-attribute associations are accounted for in the model. Consequently we extended the Rungie et al. (2005) model for heterogeneity and demonstrated that the model fit improves. Visual inspection demonstrated clearly that the *coefficient c* for component 1 captures a subgroup of brand-attribute associations which are answered in a fairly stable manner by respondents, whereas the *coefficient c* for component 2 captures brand-attribute associations that are much less stable. This model not only describes the data better, it also seems to be plausible if one considers that brand image studies always request respondents to evaluate a set of brands within one product category along the same criteria. But that not all brands position themselves along all of those attributes, making a subset of brand-attribute associations "vague". This subset can be captured by the second component. For "strong" associations we can therefore conclude that the reliability is significantly higher than the average of .3 proposed by Rungie et al. (2005) and ranges between .5 and .7.

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