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Piotr Tarka[*]

CONSTRUCTION OF THE MEASUREMENT SCALE FOR CONSUMER'S ATTITUDES IN THE FRAME OF ONE-PARAMETRIC RASCH MODEL

Abstract. The article discusses issues concerning the scale design based on one-parametric Rasch model in the context of consumers' attitudes. The first part describes the specificity of the measurement in the light of Item Response Theory (IRT). In particular the attention is paid to the nature of the dichotomous data used in the model. At last, the author presents the scale in reference to attitudes of people towards their hedonistic, consumer lifestyle.
Key words: scale, Rasch model, the nominal – dichotomous data.

I. INTRODUCTION

In social science studies, particularly in the field of marketing research, it is often assumed that measurement effect reflects the score being measured on the scale. These scores correspond to the respondents' given answers to items that compose a respective scale. Answers to the items are part of direct measurement, but the measurement itself (in the context of the empirical research study) is part of the indirect transformations where on the basis of observable variables – items, we can form new unobservable – latent variables (Thurstone, 1928; Allen and Yen, 1979).

Measurement in the field of marketing research studies is inextricably linked with the process of the phenomenon conceptualization, that is the extraction of the subject of measurement and operationalization of the concepts through the use of empirical indicators. For the properly conducted measurement process, it is essential to derive knowledge from theoretical issues underlying the field and specificity of the explored problem. Therefore, it is not just a matter of knowing technical rules, which we apply in the phase of empirical process including conceptualization and operationalization, but it is also the matter of knowing the subject of measurement from theoretical background, especially in the field in question (Sagan, 2000).

[*] Ph.D., Department of Marketing Research and Services, Poznan University of Economics.

The combination of subject theory research and technical knowledge helps the researcher to clarify and formulate appropriate content of the various empirical indicators, then analyze concepts and finally generate on their basis theoretical constructs. A set of indicators and corresponding to them subsequently theoretical constructs are further verified in reference to reliability and validity. Obviously they depend on the type of data used in measurement model.

In this article the author pays particular attention to the need of the implementation in practice of marketing research, the measurement model based on Item Response Theory. This theory is quite useful for the construction scale measured on dichotomous data. The reason for this choice is grounded on the fact that many current marketing research projects use only scaling procedure and the market phenomena measurement only with regard to ordinal scales (e.g., Likert scale). As a result the nominal scales (based on dichotomous data) are neglected (Likert, 1932; Bearden i Netemeyer, 1999).

II. THE MEASUREMENT SCALE CONSTRUCTION IN THE LIGHT OF ITEM RESPONSE THEORY (IRT)

Constructing a scale based on dichotomous data should be carried out in accordance with the underlying assumptions developed by **Item Response Theory (IRT).** These assumptions resulted from a number of publications and empirical studies made by scholars such as L. Guttman (1944), G. Rasch (1960) or Birnbaum (1968). IRT theory is an alternative method of the scale construction as compared to the Classical Theory of Measurement (KTP). And IRT model overcomes the fundamental limitation of the KTP model, namely the establishment of parallel items' positions and its reliability dependence on the characteristics of the sample. In classical approach (e.g., KTP model) the observable score is regarded as the score of a true score plus / minus the measurement error. In contrast to the KTP model (where items positions must be parallel within the scale), in the IRT model, one begins with the analysis where existing relationships between the items take the form of monotonic hierarchy. These relationships will have the nonlinear form. An example of such a scale (including such items) is a Guttman scale in which positions are hierarchical. They are arranged in a systematic and logic order consistent with the AIDA scheme (Van der Linden i Hambleton, 1997). A good example are the measured consumer's attitudes towards a brand new car:

a. *I thoroughly watched a new car model X,*
b. *I already know how the new car model X looks like,*
c. *I like the new look of the model X,*

d. *If I had the money, I would buy the new model X.*

In AIDA scheme items are arranged in their monotonic configuration. Otherwise when respondent answers "yes" to the statement C, it logically implies the answer "yes" to statements A and B. As a result on the basis of the collected answers "yes" to the question D we can predict the correct answers to the previous three questions A-B-C. The AIDA scheme also indicates another aspect of finding dimensionality in the Guttman scale, namely where items composing unidimensional Guttman scale, differ between each other in responses given by respondents to the items on that scale. This happens when there appears a strong correlation between adjacent items positions on the scale (e.g. A-B, B-C, C-D), and when a poor correlation between the items positions of A-D exists.

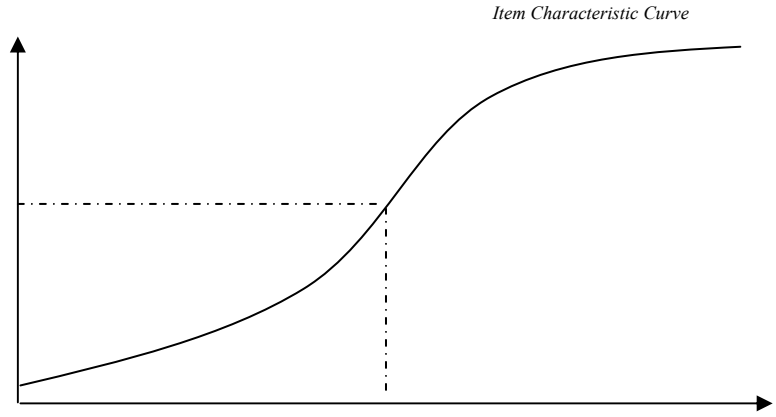

Fig. 1. Rasch model in the light of Item Response Theory
Source: own construction.

More importantly, Item Response Theory allows the researcher to determine and explain the mechanism of measuring the responses provided by respondents from two points of view: 1). property of the scale and 2). respondents' traits associated with the measured phenomenon (for example, their emotional involvement, ability, effectiveness to solve a task provided by researcher). The relationship between the overall score obtained on the scale (the latent variable) and the probability of compliance with the respective item position of the constructed scale is often portrayed through the *Item Characteristic Curve,* taking the "S" shape. This curve shows us that the ability of a respondent in response to the item on the scale. If the probability is below 0.5 then

respondent's ability is lower and his attitude is weaker than the difficulty of answering to the particular position. In this situation the respondent needs to make a greater effort and use more of his knowledge in order to respond to the item at all. If the probability is greater than 0.5, then his ability to give answer is higher and his attitude is stronger than the difficulty of answering to the item position.

III. ONE-PARAMETRIC RASCH MODEL – THE PARAMETERS ESTIMATION IN REFERENCE TO THE CONSTRUCTED SCALE

In the measurement model based on IRT theory, the parameters are estimated independently, and always refer to the same dimension. The scale (which is created by the researcher throughout IRT) remains insensitive to sample in the course of assessment of discriminatory power of individual items. Thus a scale is independent of the item position when the respondents' characteristics are evaluated. In this situation we deal with a rule of "specific objectivity of measurement" (Salzberger, 1999). The estimated parameters allows for direct comparisons of particular statements difficulty with the respondents' ability to respond to them. It is due to the fact, that in model respondents and items are placed in the same latent dimension. And this dimension determines their ability to respond to items which have varying degrees of cognitive difficulty. That is why, the IRT theory develops conceptually a much better model than the tautological classical theory of measurement (KTP).

Measurement model (based on IRT) expresses the probability of particular response to the scale items as the function of the "respondent's ability" to the "item difficulty". The parameters function in the model take logistic function, as in case of Birnbaum models. In practice, most of the research studies in social sciences use one-parametric Rasch model (for dichotomous data with the following answers such as 'Yes' / 'No'), which can be formulated as (Rasch, 1960):

$$\Pr(+\,|\,v,i) = \frac{A_v / D_i}{1 + A_v / D_i} \tag{1}$$

where:

$\Pr(+\,|\,v,i)$ – probability that, respondent v possessing the ability (knowledge, positive attitude) β will agree with the item position i at the given level of difficulty δ,

A_v – ability (knowledge, positive attitude) of the respondent v,

D_i – item difficulty level i.

Function (1) can be also expressed with the parameters β i δ (Rasch, 1960):

$$\Pr(+ \mid v,i) = \frac{e^{(\beta_v - \delta_i)}}{1 + e^{(\beta_v - \delta_i)}} \tag{2}$$

where: δ_i – parameter defining the item position difficulty level on the scale, β_v – parameter specifying the respondent's proprietary (the ability to respond to the scale items).

As mentioned the parameters of model are estimated independently of each other. And for estimation the relevance of each parameter in Rasch model, we may use the chi-square test. Thus we can mark items on the scale which have low (or high) discriminative power. The items with low discriminative power should be eliminated from the scale, and this can be checked through the high chi-square values and simultaneously low probabilities of the tested items.

IV. SCALE CONSTRUCTION FOR HEDONISTIC-CONSUMER LIFE STYLE

Here we applied one-parametric Rasch model in order to construct scale for the hedonistic-consumer lifestyle. The adopted approach followed the assumptions based on the hierarchical structure of items composition on the scale. Otherwise it was hypothesized that young consumers' attitudes to hedonistic-consumer lifestyle will take hierarchical form. Data was completely derived from empirical research study that was conducted by the author in 2010 [Tarka, 2010]. All calculations were performed in Wingen 2.0.software. The dataset comprised 232 respondents and 5 items measured on nominal scale with two category answers such as „Yes" – [1] / „No" – [0] for the following statements:

1. *Shopping improves my own well-being,*
2. *When I cannot afford to buy products due to lack of money, I take some credit,*
3. *When I already have sufficient amount of money, I visit the shopping centers,*
4. *Spending money (during shopping in the mall) gives me great joy,*
5. *Money becomes an important factor in my life to achieve a high social prestige.*

Table 1 presents the coefficients of δ for five items based on the "difficulty" level along with the information presenting standard errors of parameters and values of the χ^2 test. Test χ^2 examines degree of matching each parameter in Rasch model to the data. It allows us to check the items on the scale which have

low discriminative power, and which in fact should be eliminated. High values of χ^2 test (and associated with the test low probabilities p) mark a mismatch between the item position and hierarchical scale. This means that high and strong abilities of the respondents (e.g., positive attitudes) and easy to answer items are related to given by them response (0), and low – poor abilities (negative attitudes) of the respondents for difficult items are associated with response (1). From the Table 1 it is clear that the item position "social prestige" has a very low discriminatory power on the scale (among the other items), although there is still no strong proof to remove that item from the scale[1].

Table 1. Items difficulty coefficients for *hedonistic-consumer life style scale*

Item	Delta	SE (delta)	χ^2	*ss*	*P*
1 – „Shopping and well-being"	0.073	0.362	24.890	35	0.896
2 – „Taking the credit"	1.508	0.454	26.481	35	0.823
3 – „Visiting shopping centers"	–0.509	0.353	28.325	35	0.754
4 – „Spending money"	–0.513	0.333	30.179	35	0.721
5 – „Social prestige"	**–2.875**	**0.454**	**43.231**	**35**	**0.124**

Source: own construction in WinGen 2.0 software.

Table 2 shows already the coordinates of the points including characteristic curves for four items. The item "social prestige" was excluded from the scale. As observed, each curve describes its respective item position on the constructed scale.

Table 2. Items characteristic curve coordinates for *hedonistic-consumer life style scale*

R	Probability values Pr (+ | *v*, *i*) for respective item position				
	1	2	3	4	Beta
1	0,13	0,07	0,05	0,03	–2,47
2	0,28	0,24	0,18	0,12	–1,45
3	0,48	0,45	0,29	0,27	–0,68
4	0,67	0,61	0,47	0,42	0,00
4	0,67	0,61	0,47	0,42	0,00
4	0,67	0,61	0,47	0,42	0,00
5	0,88	0,77	0,67	0,67	0,65

Source: own construction in WinGen 2.0 software.

Legend: 1 – „Shopping and well-being", 2 – „Taking the credit", 3 – „Visiting shopping centers", 4 – „ Spending money".

[1] However, due to the uncertain value of "social prestige" item, author decided to eliminate it from the scale.

At last we should take into account the mutual position of all items (see Figure 2). The parallel position of the curves represents equally set items, that have equal discriminatory power.

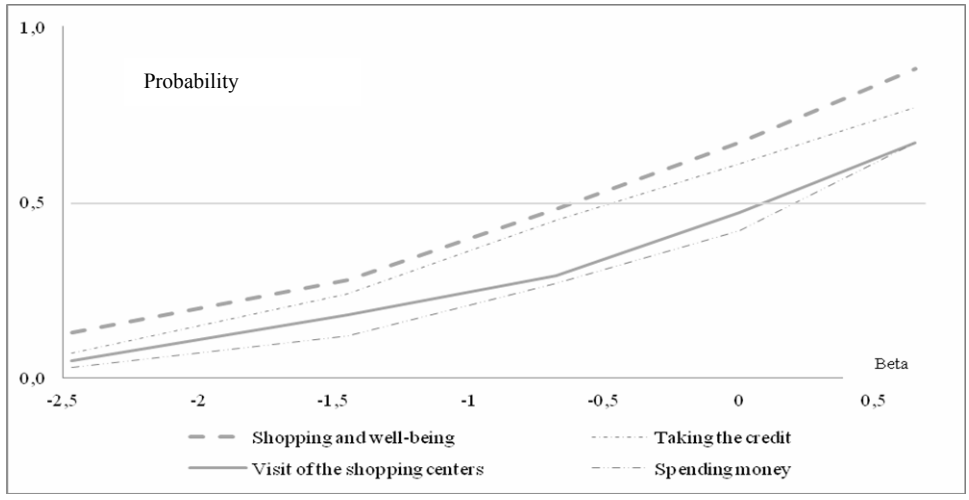

Fig. 2. Items characteristic curves for *hedonistic-consumer life style scale*
Source: own construction in WinGen 2.0 software.

V. CONCLUSIONS

The analysis proves a strong relationship between theoretical assumptions of the scale to be constructed and used for it a measurement model in reference to IRT background. Measurement in the social sciences research, (including also marketing research, e.g., consumers' attitudes) is not free from the influence of theory. And in the author's opinion researchers who use almost exclusively the classical theory of measurement, should also add some alternative measurement like Rasch model (grounded on IRT theory) which would significantly enrich and improve the procedure scaling items.

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Piotr Tarka

KONSTRUKCJA SKALI POMIARU POSTAW KONSUMENTÓW W UJĘCIU JEDNOPARAMETRYCZNEGO MODELU RASCHA

W artykule autor omawia zagadnienia dotyczące konstrukcji skali pomiarowej postaw konsumenckich w kontekście jednoparametrycznego modelu Rascha. W pierwszej części opisano specyfikę pomiaru w świetle teorii reakcji na odpowiedzi (IRT) oraz założenia teoretyczne stanowiące podbudowę konstrukcji skal pomiarowych. Szczególną uwagę zwrócono na charakter danych dychotomicznych. W końcowej części opracowania zaprezentowano problem badawczy w sferze konstrukcji skali do analizy postaw konsumentów wobec konsumpcyjno-hedonistycznego stylu życia. W pomiarze wykorzystano jednoparametryczny model Rascha.