Technophobia as a Hindrance to International Innovation Diffusion - A Multinational Investigation of Construct Equivalence

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Abstract

"Technophobia" renders consumers less open to innovative technology-related products and can therefore be a major obstacle to the diffusion of these products. Data from an empirical study measuring "technophobia" is used to compare the phenomenon across seven countries. Since international business research is confronted with many methodological problems, special attention is paid to fundamental measurement issues. Although the increasing importance of international business has given rise to cross-national research methods and analysis, some methodological mystique still persists. By referring to Rasch measurement theory, the current paper focuses on advanced techniques for establishing equivalence. Compared to previous classical analyses, remarkable differences in terms of construct equivalence (dimensionality) occurred. In addition, country-specific patterns of criterion-related validity were found suggesting a different role of technophobia in different countries.

Introduction and Purpose

Advancements in international business research are largely a function of empirical generalisations resulting from meaningful comparisons of constructs and associated measures. Issues of reliability, validity as well as dimensional consistency need to be addressed (Davis, Douglas, and Silk 1981; van de Vijer and Leung 1997) in order to avoid misinterpretation of results and fallacious conclusions for managerial decision making.

On the one hand, advancements in statistical and computational methodologies and procedures (Tabachnick and Fidell 2001) have helped solve methodological problems. On the other hand, applied researchers and practitioners are faced with an accumulation of competing frameworks and methods for analysing cross-national datasets (van de Vijer and Leung 1997). Scholars have looked at measurement equivalence issues from both a qualitative and quantitative perspective (Mullen 1995; Salzberger, Sinkovics, and Schlegelmilch 1999; Singh 1995). Multi-group structural equations modelling, which is grounded in classical test theory, has gained much popularity (see e.g. Steenkamp and Baumgartner 1998).

The main purpose of this paper is the investigation of the construct validity of the technophobia scale in a multinational context. Technophobia has been introduced by Sinkovics et al. (2002) to assess a negative attitude of consumers towards certain innovative products, which results in their being less open to these products, feeling uncomfortable when using them and disregarding technological benefits related to their use. We choose the Rasch measurement theory (RMT, Rasch 1960) as an appropriate methodological approach for re-assessing and re-evaluating the original findings. While still largely underutilized, the methodology builds upon a convincing definition of measurement.

Conceptual Foundation of Technophobia

The Anglo-American literature offers a multitude of conceptual foundations for technophobia, particularly pertaining to synonyms such as *techno stress* (Brod 1984), *cyberphobia* (Price and Ridgeway 1983), *computer aversion* (Meier 1988) or *computer anxiety* (Raub 1982). The findings however, are largely restricted to “computer”-phobia, as computers were used as anchor products. Scholars have argued that computerphobia and technophobia relate to the same latent variable (Rosen and Weil 1990a; Rosen and Weil 1990b). However, in view of potential generalization problems in the international context, Sinkovics et al. (2002) established a generic technophobia scale that is applicable to a variety of products and services. The scale is exemplified by referring to automated teller machines.

Their instrument is deemed to represent negative psychological reactions towards technology, which can arise in various forms and intensity. Hereby the term ‘phobia’ is not used in a strict medical sense, relating to the results of the exposure to a feared situation (often demonstrated in symptoms such as sweating, tremors, flushing, etc.), but the notion of phobia implies rational (Röglin 1994) and – what is even more – irrational psychological aspects to the anxiety (Jaufmann 1991). The authors derive a three-dimensional factor-structure for technophobia (Sinkovics et al. 2002). The first factor relates to "personal failure", i.e. issues describing problems, frustrations, and failures when using sophisticated or innovative machines, the second factor represents issues which elicit the ambiguity between human and machine interaction, i.e. fears about machines dominating interactions. Lastly, the third factor is related to "convenience" issues, when using machines.

Methodology: Rasch Measurement Theory (RMT)

RMT provides a sound framework for measurement of constructs that allow for their operationalization by what is usually referred to as reflective indicators. In particular, RMT yields a deeper insight into the nature of the construct compared to classical approaches. Second, the methodology applied has proven to be highly suitable for cross-cultural data.

In our context, the standard Rasch model for polytomous items, the partial credit model (Andrich 1988), has been applied. The model feature which is most strikingly different from classical approaches, is the idea that items are ordered along the continuum on which the respondents are assessed. In other words, the dimension of interest is defined by the items and their locations on the dimension. This requires a specific parameter for the item besides the person parameter telling us where the respondent is located on the latent dimension. Polytomous items necessitate the estimation of more than one parameter, namely k-1 so-called threshold parameters with k categories provided. In a logistic equation, the person parameter and the thresholds specify the probability of a respondent to choose a particular answer category.

For measurement to be reasonable, among other prerequisites, we require the respondents’ answers to be on an ordinal scale (Rasch models do not interpret usual Likert scales as metric data as classical approaches usually do). More often than not, real data falsifies even the assumption of ordinal raw data. In RMT, the manifestation of this fact is reflected in a disordering of thresholds within an item.

Construct validity in a multinational environment inevitably leads to the problem of equivalence, i.e. whether measures are derived from observations in the same way and imply the same meaning across cultures. We will address this issue by examining deviations of actual proportions of specific item categories and the probabilities predicted by the model. Any deviation that can be attributed to country demonstrates non-invariance of the item,

technically referred to as differential item functioning (DIF). The estimation of a separate parameter for a specific country allows for linking a non-invariant item to a common scale. Ideally, there should be a plausible explanation for why the item displays DIF.

Consequently, the steps of the investigation of the technophobia scale are: first, the threshold parameters of all items are examined; second, in the case of reversed thresholds, categories are collapsed until re-estimated threshold parameters show a correct order; third, misfitting item are identified and tests for DIF are carried out (ANOVAs on the residuals as dependent variables and country as an independent variable); fourth, items misfitting in all countries are discarded, while items displaying DIF are split up by country in order to estimate specific parameters.

Since the partial credit model assumes a unidimensional construct, a violation of this fact in many cases leads to misfit of items measuring other latent dimensions. Therefore, if items to be discarded suggest having something in common then a further dimension should be considered and, consequently, a separate model should be set up.

Empirical Analyses

Data

To illustrate the outlined procedure, data from a large multi-country survey of consumers originating in the U.S. (n=93), U.K. (n=278), France (n=172), Spain (n=208), India (n=103), Mexico (n=200), and Austria (n=449) by Sinkovics et al. (2002) is used. The original study established a measure for the concept of 'technophobia' and comprised additional measures such as 'innovativeness' (Hirschman 1980; Price and Ridgeway 1983). The items used five-category Likert scales. Sinkovics et al. developed the 'technophobia' scale and found reasonably well reliability scores and indications for validity, based on confirmatory multi-group structural equations modelling procedures.

Descriptive results

The most relevant descriptive data in the context of this paper pertains to ATM card ownership, which is significantly different in the 7 countries considered (ANOVA: $F=53.739$, $p<.001$.). While only 23.3 % of the Indian respondents own an ATM card, in Mexico 73 % possess such a card and in Austria 75.9 %. Spain follows with 80.3 %. The US (93.4 %), the UK (93.1 %) and France (94.2 %) show the highest adoption rates. Moreover, respondents from these countries have been using ATM cards longest. The difference in ATM card ownership was considered to be the result of unequal stages of technological development and product diffusion patterns for automated teller machines.

With regard to the ATM card usage the sample data revealed that in the U.S., U.K., France and in Austria cards are most frequently used. In these countries ATM cards are used at least twice, sometimes three times a week. In India, ATM cards are used two to three times per month which indicates significant (Pearson $\chi^2= 292.84$, $df=42$, $p<.001$) structural differences in ATM card usage across the seven countries of the study.

Results of the Rasch analysis

The examination of the thresholds revealed that for 17 items (of a total of 30 items) some disordering occurred. In most cases, the problem could be solved by collapsing the middle category labelled *neither agree nor disagree* and the adjacent *somewhat disagree* option.

Technically, this means that people don't use the neutral category to express some intermediate level of (dis)agreement but more likely choose between *somewhat agree* and *somewhat disagree*. For some items only two options turned out to work as intended. When rating the item *I feel comfortable when using ATMs*, for instance, respondents effectively only made a distinction between agreement and disagreement.

In terms of item fit, several items showed clear underdiscrimination, i.e. with rising technophobia there is only a small increase in the probability of agreement with these items. However, discarding these items has not resulted in a reduction of content validity since other items covering the same or similar facets have been retained. Interestingly, all but one item featuring reverse coding have turned out to be very problematic. Obviously, many respondents interpret these statements differently.

In sharp contrast to the three-dimensional solution derived by classical procedures, the Rasch analysis gets along with just one dimension. The question remains whether or not the Rasch based scale ignores important facets of the construct. One dimension, abandoned from the classical analysis ("convenience"), mainly consists of reverse coded items (i.e., the more agreement the less technophobia). This suggests that it might rather be a methodological artefact rather than a substantially important additional dimension. A separate Rasch analysis confined to these items proved highly unstable and lacked sufficient item fit. The other neglected dimension labelled *human versus machine* could partly be integrated into the basic dimension of technophobia while some indicators showed misfit.

Table 1: Rasch-results for the Technophobia-scale

Item	*Item Overall Location (extreme thresholds)*
Machines should not handle people's money transactions (AUSTRIA)	-2.282 (-3.264, -1.042)
Machines should not handle people's money transactions *(except AUSTRIA)*	-0.801 (-2.675, 0.679)
I worry about making mistakes when using ATMs	-0.574 (-2.062, 1.361)
I think most people know how to use ATMs better than I	-0.396 (-2.16, 1.503)
It takes me a long time to complete bank transactions when using an ATM	-0.341 (-1.679, 0.832)
I don't trust ATMs with my money	-0.229 (-2.118, 1.758)
I feel inadequate about my ability to use ATMs *(except AUSTRIA)*	-0.164 (-1.512, 0.635)
I refuse to use ATMs	-0.158 (-1.23, 0.913)
I find ATMs' instructions confusing	-0.089 (-2.443, 1.251)
ATMs seem very complicated	0.054 (-2.078, 2.388)
ATMs agitate me	0.118 (-1.528, 1.621)
I feel frustrated when I use an ATM	0.172 (-1.589, 1.288)
Using ATMs is time-consuming	0.184 (-1.426, 0.941)
ATMs are intimidating *(except AUSTRIA)*	0.458 (-1.709, 3.345)
ATMs are intimidating (AUSTRIA)	0.851 (-0.254, 2.261)
I feel inadequate about my ability to use ATMs (AUSTRIA)	1.263 (0.597, 2.101)
I feel confident that I could teach someone how to use an ATM (reversed)	1.936 (2 categories only)
Person location (country means): -2.40 Austria, -2.35 France, -1.82 USA, -1.40 Spain, -1.29 UK, -1.09 India, -0.88 Mexico; -1.73 overall; ANOVA: F=30.67, df=6, p<.0001	
Total item chi-square=438.08, df=153; Person-Separation Index=.93	

The final instrument derived by a Rasch based analysis consists of 14 items. The person-separation index, which compares to internal consistency in classical analysis, amounts to an outstanding .93 yielding very high power for the test of model fit. In terms of DIF, only three of the 14 items required a separate parameter estimation, which was confined to the Austrian sample. The item location parameters (see table 1) reveal interesting insights into the structure of the construct. In all countries including Austria, the statement *Machines should not handle people's money transactions* is most easily agreed with, i.e. even respondents with a very low

degree of technophobia adhere to the notion that ideally it should be human beings who handle financial transactions. It is slightly more characteristic of a mild degree of technophobia that people worry about making mistakes and think that others know better how ATMs are used. A stronger degree of technophobia is accompanied by affirming one's refusal of using ATMs while even more severe technophobia is best expressed by frustration and intimidation. Two issues are somewhat surprising. First, whereas in all countries but Austria, the respondents' feeling of having inadequate ability to use ATMs has about the same location as the refusal of ATMs, in Austria a much stronger technophobia is required to agree with this statement. Second, in all countries people feel remarkably confident to be able to teach others how to use ATMs. In other words, it is not the lack of knowledge (at least not a subjective lack) that triggers technophobia but a deeper dislike for machines handling financial transactions. This argument is supported by the ease with which respondents agree to *machines should not handle people's money transactions.*

In general, respondents from the seven countries under scrutiny show a negligible to moderate degree of technophobia. There are, however, significant differences (ANOVA; $p < .0001$) between the countries. Austria and France are the least technophobic countries considered in the analysis. The mean of the US sample also lies below the average of all seven countries whereas Spain and the UK display a stronger degree of technophobia on the average, at least compared to the three aforementioned countries. Although India and Mexico rank first in terms of average technophobia, compared to the items' location even respondents from these countries hardly can be said to suffer from strong technophobia.

Further evidence of validity

While the Rasch analysis demonstrates construct and also content validity, further evidence of criterion-based validity is indispensable. Consequently, the technophobia score was correlated with the 'use innovativeness' measure, as established by Price and Ridgeway (Hirschman 1980; Price and Ridgeway 1983). The construct deals with the use of previously adopted products in novel ways and encompasses five factors: creativity/curiosity, risk preferences, voluntary simplicity, creative reuse, and multiple use potential.

The Rasch-based technophobia score shows significant ($p<.001$) and – as expected - negative correlations with 'risk preferences' ($r=-.136$), 'voluntary simplicity' ($r=-.222$) and 'creative re-use' ($r=-.195$), as well as with the overall 'use-innovativeness' score ($r=-.140$). Investigating these correlations by country shows quite interesting differences in the patters. Particularly in the US no significant correlations could be identified. Furthermore in Spain, only Risk preferences and in India, solely 'creativity, curiosity' demonstrated significant correlations with technophobia. In all other countries more than two dimensions of innovativeness demonstrated significant correlations.

Summary and Implications

The Rasch analysis strongly supports the construct validity of the technophobia measure. In contrast to previous classical analyses, only one meaningful dimension was established. In terms of cross-national comparability, only for the Austrian sample adjustments were necessary. However, this may partly be due to the larger sample size in Austria rendering differences significant. While correlations with related constructs demonstrate criterion related validity of the scale, clear differences in these patterns across countries prevail. Even when accounting for different sample sizes, the criterion-related validity of the technophobia measure seems to be country-specific. Further attempts to investigate the criterion and nomological validity will help determine the specific suitability of the instrument.

Despite its satisfying quality, the scale itself offers room for further improvement. Whereas the items are reasonably widespread in terms of content, a wider distribution regarding their locations would be desirable. Given the generally low degrees of technophobia, items should be added that are better targetted to 'mild' levels of technophobia.

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