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A psychometric theory that measures up to marketing reality: An adapted Many Faceted IRT model

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ABSTRACT

The marketplace has been defined by the interaction between consumers and brands, which has been recognized by the majority of marketing literatures with the exception of the measurement literature. Measurement researchers in marketing have been continuously working on improving the quality of measurement of marketing constructs by applying psychometric theories from the early Classical Test Theory to later generations such as Generalizability Theory and Item Response Theory. But only main effects (normally consumers, sometimes brands) have been focused on, and interactions between them are either ignored or treated as measurement error. This is surprising, given the voluminous literature in other areas of marketing (e.g., marketing segmentation, customer lifetime value, and customer relationship management) that build their entire frameworks on the interpretation and usage of this interaction. In the current research, we propose a new Many Faceted Item Response Theory model to fill this gap in measurement literature. Two sets of indexes describe consumers (and brands); individual main effects (and brand main effects) and brand-specific individual effects (or individual-specific brand effects). Soft drink brand equity data were used for the empirical examination.

CHINESE ABSTRACT

符合市场行销现实的心理计量学理论：
适合多元化项目反映理论的模型

消费者和品牌之间的互动界定了市场的所在，这一点得到绝大多数市场文献(除测量方面的文献以外)的认可。从一开始使用早期的经典测量理论到后来使用概化理论和项目反应理论，市场的测量研究人员已经连续投身于改善“营销构念”的测量质量工作。但只有主效应(通常为消费者，有时为品牌)获得关注，两者之间的互动则会被忽视或当作测量错误。这令人感到惊讶，考虑到市场营销其他领域的大量文献(如市场细分化、客户终身价值，以及客户关系管理)在这种互动的诠释和利用方面建立完整的框架。于是我们在当前的研究当中提议建立新的多元化项目反映理论模型，以填充测量文献中的这一空白。利用两套指标描述消费者(和品牌)；个别的主效应(和品牌主效应)以及品牌特定的个别效应(或个别特定的品牌效应)。实证检验中使用的数据为软式饮料品牌的数据.

1. Introduction

Churchill (1979, p. 73) reiterated an often-expressed view that “Progress in the development of marketing as a science certainly will depend on the measures marketers develop to estimate the variables of interest to them.” Churchill’s (1979) paradigm for developing better measures of marketing constructs changed how the discipline viewed measurement. Marketers wholeheartedly adopted Classical Test Theory (CTT), using multiple items to measure marketing constructs and faithfully reporting their reliability statistics (see the Office of Scale Research database of 2600 scales). But CTT has its roots in educational psychology, where persons can safely be assumed to be the objects of measurement. Consumers (persons) are important marketplace participants, but they are not the only ones. Other entities (such as brands, firms, or service providers) jointly define the marketplace with consumers, and they also need to be measured in substantive areas of marketing. For example, choice map (Elrod, 1991) positioned brands in a multiple dimensional space, while treating

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consumer heterogeneity as of non-fundamental importance and so readily taken care of by an assumed distribution. Similarly, in country of origin literature, consumers' ratings or rankings of the country stimuli were used to map the countries and consumers were pictured as the distribution of ideal points without their own identities (Balabanis and Diamantopoulos, 2004).

Marketing researchers (Peter, 1979; Rentz, 1987; Finn and Kayande, 1997) borrowed psychology's Generalizabilty Theory (GT) (Cronbach et al., 1972) to address this limitation of CTT. GT allows for multiple objects of measurement, so it is applicable to research measuring consumers, brands, or other market entities. It quantifies how measurement reliability differs for these different objects of measurement (Brennan, 2001).

However, other measurement issues are yet to be addressed. The most important one originates in how measurement researchers implicitly view the marketplace when they assume marketers just scale consumers or other entities (such as brands) separately. The marketplace is actually more complex; measurement can be about more than just the main effect of a single type of objects. For example, researchers can have consumers each evaluate multiple brands on a number of items. Such data no longer fit in a matrix (with rows representing consumers and columns representing items), they need a three-way array (with brands the added dimension). The measurement literature has moved beyond CTT and partly addressed the nature of such multiple way data. Consumers or brands were treated as the objects of measurement using GT (Finn and Kayande, 1997). The interaction between consumers and measurement instrument (i.e., items) was modeled using Item Response Theory (IRT) (e.g., de Jong et al., 2007). However, the interaction between two types of objects involved (here consumers and brands) remains neglected and is treated as measurement error in CTT, GT and IRT, even though this interaction is extremely important. It represents how consumers respond to competing brands, which is of substantive interest and should not just be treated as measurement error. There would be no theoretical basis for market segments or consumer level strategies (e.g., customer lifetime value, and customer relationship management) if differences in consumer responses to brands were simply measurement error. But that is exactly what is assumed in the existing measurement literature in marketing; the underlying consumer (brand) trait is assumed to be constant for all brands (consumers).

To address this deficiency, we propose an extension of Many Facet Item Response Theory (MFIRT, Linacre, 1989) that explicitly models both the main effects of objects (e.g., brands and consumers) and their interaction. The model also accounts for measurement instrument effects (such as dimensions and items) and the ordinal nature of marketing rating scale data. We use consumer-based brand equity (CBBE) as an application area to demonstrate our method. Our research is the first measurement paper to recognize the segmented nature of the marketplace. One set of scores for each individual and one set for each brand is insufficient to characterize a marketplace. Our model reflects the reality of the marketplace and catches up with other research in marketing (such as econometrics modeling), where researchers model and make inferences about the interaction between consumers and brands.

2. Literature

2.1. Systematic consumer heterogeneity

It has long been recognized in marketing literature that consumers are different from each other. But the reason for this difference apparently drifts measurement literature from other modeling areas (such as consumer choice models). Measurement literature roots in psychology in which people are naturally different from each other on an underlying trait of consumers' that psychologists try to measure (such as writing proficiency, Brennan, 2001). However, in marketing, most of the times, for managers, the meaningful differences among consumers are generated by marketing variables (e.g., marketing mix or brands). For example, consumers' price sensitivity was found to be brand specific (Erdem et al., 2002) and consumers did interact with brands to form their sensitivity to price. The interaction between brands/products and consumers (in terms of price sensitivity, brand loyalty, or general evaluation) is the most important rationale for market segmentation, customer lifetime value (CLV), and customer relationship management (CRM). This term plays a key role in the marketing strategies of almost all successful organizations and is a powerful marketing tool. However, the marketing measurement literature is left way behind the development of other marketing areas in terms of the examination and interpretation of this interaction effect. For example, when consumers were asked to evaluate three brands, their responses were analyzed separately for each brand (Netemeyer et al., 2004) without recognizing that the same consumers evaluated the same brands. We think the reason for this practice is that the authors may realize that brands systematically changed the way consumers responded, but due to the existing measurement methods in marketing, this interaction could not be fully examined. Next, we will discuss each of the major measurement methodologies in marketing.

2.2. Measurement theories

2.2.1. Classical Test Theory

Classical Test Theory (CTT) has been the foundation for psychological measurement theories for over 80 years. It assumes that the raw score (X) obtained by any one individual is made up of a true component (T) and a random error (E) component:

$$X = T + E \tag{1}$$

In a marketing setting, for any evaluation where consumer r evaluates brand b on item i, the observed score X_{bri} is the sum of the individual true score ν_r and the random source of error (ν_{error}) that may include both the main effects (brand ν_b and item ν_i) and the two and three way interactions among brand, consumer, and item (ν_{br}, ν_{ri}, ν_{ib}, and $\nu_{bir,e}$). Although in some development of CTT, systematic sources of error such as main effects like ν_b have been recognized (e.g., Churchill, 1979), the major focus is still on the individual trait (ν_r).

$$X_{bri} = \nu_r + \nu_{error} (= \nu_b + \nu_i + \nu_{br} + \nu_{ri} + \nu_{ib} + \nu_{bir,e}) \tag{2}$$

The assumptions of CTT have been well researched. For example, the errors would be random and normally distributed. In addition, those errors are uncorrelated with each other and to the true individual score. These assumptions apparently are difficult to be held with the involvement of brand due to the complicated composition of the error term. More importantly, the information about the brand variance and the interactions that can be useful for researchers and managers get ignored and dumped into the garbage can.

2.2.2. Generalizability Theory

Generalizability Theory (GT), developed by Cronbach and colleagues (see Cronbach et al., 1972), is a statistical theory about the dependability of behavioral measurements. It liberalizes CTT, in part through the application of analysis of variance procedures that focus on variance components. It has long been identified as useful for marketers (Peter, 1979; Rentz, 1987; Finn and Kayande, 1997), as they try to scale different objects of measurement (e.g., consumers, brands, or service providers).

GT addresses the classical test concept of error as being undifferentiated and randomness is also replaced with the identification