

An Application of Vanishing TETRAD Analysis to a Brand Model

Bradley Wilson, * William Callaghan and Gillian Stainforth*****

Aaker's (1995) seminal work in constructing a scale to measure brand personality has reinvigorated research in this area. Her work and those that have subsequently used the brand personality scale have followed conventional analysis procedures (exploratory factor analysis and confirmatory factor analysis) and typically assume a reflective structure. In this study we consider the possibility that trait indicants could be better conceived as formative measures rather than reflective ones. A review of the literature in the structural equation modeling domain and also the literature on human personality has suggested that researchers have not paid sufficient attention to such issues. In the personality area the paper responds to the call of key psychometricians (Bollen and Lennox, 1991; Jarvis, MacKenzie and Podsakoff, 2003) to consider these issues indepth. We apply Vanishing Tetrad Analysis (Ting, 1995) to different levels of brand personality within a broader brand relationship structural model to assess the merits of a formative modeling approach in this area. The Tetrad analyses and further structural modeling establish that brand personality is best treated as having a reflective specification.

Keywords: Formative and Reflective Measurement Issues, Tetrad, Brand Personality, Brand Image

1. Introduction

Since the late 1980's the area of brand measurement has increasingly been an acknowledged concern to both academic and practical researchers (Barwise, 1993) The Marketing Science Institute has attributed brand equity a high priority by commissioning research and running conferences on the subject. Numerous other professional bodies have followed suit. These activities have raised awareness of the topic and lifted brand measurement to the top of the business agenda for a number of researchers and corporate managers. Given the trend towards global brand management practices, an understanding of the mechanisms of how consumers view and conceptualise branding is becoming increasingly crucial in both short and long term strategic decision making activities for firms worldwide.

* Bradley Wilson, Postgraduate Lecturer in Advertising. School of Applied Communication. RMIT University. Melbourne, Australia. Email: brad.wilson@rmit.edu.au

** William Callaghan, Faculty of Business and Enterprise, Swinburne University. Melbourne, Australia.

*** Gillian Stainforth, Discipline Leader of Advertising. School of Applied Communication. RMIT University. Melbourne, Australia.

One area of brand equity of interest is that of brand personality. Aaker's (1995) seminal work in constructing a scale to measure brand personality has reinvigorated research in this area. The goal of this paper is to investigate the nature of relationship in this area by applying the Vanishing Tetrad test to the linkages between brand personality and brand relationship quality. This test was chosen as it is a confirmatory test that assists the researcher in providing further evidence to assess the directionality of paths between indicants and constructs. Jarvis, MacKenzie and Podsakoff (2003) contend the tetrad test is best utilised in concert with other qualitative theoretical determinants for path directionality.

This paper first presents the relevant literature from which a structural model is developed. Then follows a review and discussion of the measurement and modeling issues pertaining to path directionality at the single construct level and within the broader structural model. This leads to the vanishing tetrad test, its evolution and its nature. The formative and reflective aspects of the brand personality model are then evaluated using the vanishing tetrad approach and the results considered.

2. Literature Review

The following literature review section first outlines some of the basic principles of measurement pertaining to path directionality. Then the first major measurement model of interest (brand personality) is examined with particular attention paid to its derivation and on issues of path directionality. Given the relative infancy of brand personality research we elaborate on some of the measurement criticisms and issues that have been outlined within the human personality research domain. We believe these concerns should be understood and addressed in the brand personality research realm. Finally, we present literature germane to the development of the brand relationship quality construct.

2.1 An Introduction to Key Measurement Issues

All social researchers analysing questionnaire items and relations between latent variables must make decisions about the directionality of all path relationships. Diagrams are a key tool in representing such relationships. In this paper we have followed standard structural equation diagram convention. A circle is used to represent a construct or latent variable, while the boxes represent associated manifest or indicator variables (that is, the questionnaire items measured). The relationship between the latent variables and their indicators is often referred to as a "measurement" model. Within this context, it is important to note that there are arrows that go from circles to rectangles, or in the case of structural relationships, circles to circles. The directionality of the arrows linking items and constructs can concern the item-to-construct level or it can also apply to relations that occur at a higher order level of abstraction (eg. second order construct representations and within structural models).

Conventionally, there are two main types of indicators that are discussed in the literature; reflective (effect) and formative (causative). There is also a third less common model which is a hybrid of these. These are each considered in turn.

The first type of indicators are called reflective measures which are also referred to as a Mode A representation. As the term implies the indicators reflect the latent, unobservable variable. Bollen and Lennox (1991) see reflective indicators as dependent on a latent variable. As the latent variable determines its indicators, the causal direction flows from the latent variables to the reflective item indicators (see Figure 1a). Fornell and Bookstein (1982, p. 292) believe that “constructs such as “personality” or “attitude” are typically viewed as underlying factors that give rise to something that is observed. Their indicators tend to be realized then as reflective (emphasis added).” Changes in the latent variable would necessarily lead to a corresponding change in all reflective indicators. One of the conditions of reflective indicators is that they should be highly correlated with one another. Each latent variable is considered a unidimensional concept.

Williams et al. (2003, p. 906) viewed formative indicators “as causes of the construct, such that variation in the measures produces variation in the construct”. Some authors refer to formative indicators as causal indicators (Bollen and Lennox, 1991) that create emergent constructs (see Figure 1b). This is also commonly known as a Mode B representation. When using formative indicators we represent a distinctive dimension of the construct, indicating that the construct must be a multidimensional concept. The classic example is socio-economic standing (SES) being comprised of education, occupation, and income. Fornell and Bookstein (1982) considered the variables measuring the “marketing mix” to be formative, as would the belief evaluation in the Fishbein and Ajzen (1975) attitudinal model (adapted from Jarvis, MacKenzie and Podsakoff, 2003). Therefore, the correlations among the indicators are not necessarily high. A change in the latent variable may result from a change in any one of the indicators, while the others remain unchanged. In order to adequately capture a formative construct, ideally the universe of pertinent items should be included in the questionnaire because removing one indicator from the model would lead to dire repercussions as it “changes the composition of the latent variable” (Bollen and Lennox, 1991, p. 308). Thus the implication is that the complete set of relevant indicators should be included in measuring such constructs.

Another concern with formative measures is the requirement that indicators be relatively independent of one another and so it is important to check for multicollinearity. Kleinbaum, Kupper and Muller (1988) suggest the indicators should not exhibit variance inflation factors of more than the common cut off of 10. Another analytic limitation is that formative indicators cannot be analysed using exploratory factor analysis as the indicators should be reflective in nature if this method is to be utilised. In addition standard unidimensionality (reliability) and validity tests cannot be used with formative constructs and validity is often supported only with the formative index related within a nomological structure or by analysing an appropriate MIMIC (multiple indicator multiple cause) model (Diamantopoulos and Winklhofer, 2001). Indicator elimination with a formative model should therefore be considered very carefully as the conceptual meaning of the construct can significantly change when even an insignificant formative item is deleted from the model.

Finally, it is possible to have a type of indicator representation called Mode C in which we can have an arrow scheme that uses both formative and reflective indicators to represent the one construct (Chin and Newsted, 1999) (see Figure 1c). As a Mode C representation is not of focus in this work it is not discussed further.

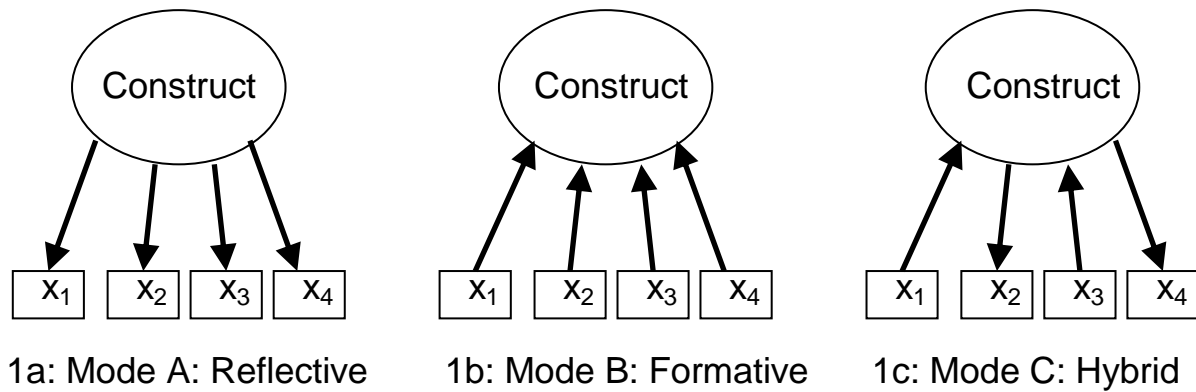


Figure 1a-c: Alternative First Order Construct Specifications

The correct specification of path directionality is imperative for researchers. As well as impacting on the basic conclusions drawn from a modeling exercise it also influences other decisions such as the choice of an appropriate data analysis method and the nature and number of items that are necessary in the questionnaire representing a particular construct. Bollen and Lennox (1991) believe that if the measures are reflective, a small sample of measures from the population of measures of the construct is sufficient to represent the construct. On the other hand formative measures require a large number of items to adequately tap into the construct conceptual domain. Formative items are often formed into an index with the use of regression analysis. The constructs created are often linear combinations of their own items. Diamantopoulos and Winklhofer (2001) provide guidelines regarding formative index construction. A popular method for creating formative indices is featured in a study by Reinartz, Krafft and Hoyer (2004). The indicator type also determines the applicability of certain data analysis methods. An underlying assumption when using covariance-based structural equation modeling and exploratory factor analysis is that the indicators used to measure a latent variable are reflective in type. Formative models can be estimated in covariance-based structural equation models but there are some particular issues that must be addressed for adequate model identification (Diamantopoulos, 2006; Jarvis, MacKenzie and Podsakoff, 2003). Chin (1998a, p. ix) has recognised that, “a common and serious mistake often committed by research is used to inadvertently apply *formative* indicators in a (covariance-based) SEM analysis.” This concern has also been empirically proven by Jarvis, MacKenzie and Podsakoff (2003) who illustrated after searching back 24 years (1977-2000) for all covariance-based structural equation modeling articles featured in the top four marketing journals (Journal of Marketing, Journal of Marketing Research, Journal of Consumer Research and Marketing Science) that 29% of constructs were modelled incorrectly. When the construct was modelled incorrectly by far the majority of these constructs and items should have been treated in a formative fashion but instead they were analysed as if they were reflective in nature. Not considering these issues within a piece of scholarship can lead to significant doubt and criticism being directed at the findings given that it is clearly incorrectly specified and analysed. Formative indicators are often neglected despite them being most appropriate in many instances (Bollen, 1989).

Other researchers have experienced problems and criticism when they have considered these reflective and formative issues post hoc (Nueberg et al., 1997).

Researchers have an obligation to discuss these issues during the theoretical development stages of their research and if the issues are not clear cut then appropriate quantitative tests should be used as a decision aid. Jarvis, MacKenzie and Podsakoff (2003) provide a comprehensive series of qualitative decision rules to determine whether the measures and constructs are either reflective or formative. A number of the points covered provide a "logic check" for the researcher to determine issues of directionality before the data is collected and subsequently analysed. The other choice the researcher has is to run a more confirmatory test called the Vanishing Tetrad test (Bollen and Ting, 1993, 1998; Ting, 1995). This test is implemented after the data has been collected (see later discussion). It is our belief that researchers can probably benefit from using a combination of both approaches in most research instances.

2.2 Brand Personality

The concept of brand personality was popularised by the well known advertiser David Ogilvy. According to Dowling (1994, p.5) "(Ogilvy's) main insight was that giving a product a 'personality' is a key factor for market success. His guiding premise was that consumers do not buy products, rather they buy products with a personality, namely 'brands'." Brand personality has been described by some as being a key component of brand image (Keller, 1993).

Marketers' have long been trying to embed their brands with personalities to encourage some degree of person-brand personality congruence (Sirgy, 1982). The idea of brand personality is familiar and accepted by most advertising practitioners (e.g., Plummer, 1985) and many marketing academics (e.g., Gardner and Levy 1955). Brand personality as defined by Aaker (1997, p. 347) is "the set of human characteristics associated with a brand". Aaker (1995) and Fournier (1994) have argued that brand personality is an important topic of study and these researchers have used a range of tools to identify and measure brand images and brand personalities.

An alternative brand personality definition was presented by Allen and Olson (1995, p. 393) defining, "brand personality as *the specific set of meanings which describe the "inner" characteristics of a brand. These meanings are constructed by a consumer based on behaviors exhibited by personified brands or brand characters.*" (italics in original). Their work suggests that consumers draw inferences from behaviours enacted by the brand or the brand character in advertising. Their advice "is that marketers need to show the brand "doing things" in their advertising. (Allen and Olson, 1995, p. 393)". This view suggests the need to transform the passive inanimate object (brand) into an active animate object with person-like qualities.

It has been argued that brand personality can be influenced by any direct or indirect contact a consumer has with a brand (Plummer, 1985). Jennifer Aaker (1997, p. 348) believes that, "personality traits come to be associated with a brand in a direct way by the people associated with the brand- such as the brand's user imagery, which is defined by her as "the set of human characteristics associated with the typical user of a brand; the company's employees or CEO; and the brand's product endorsers". Aaker and Fournier (1995, p. 394) emphasize that, "personality, is used differently in the context of brands (consumer behavior) than in the context of persons

(psychology). For example, while a person's personality is determined by multidimensional factors (e.g., appearance, traits and behavior), a brand, by its nature of being an inanimate object, has a personality that is determined by different factors (e.g., attributes, benefits, price, user imagery)". They indicate that by the process of meaning transfer the consumer engenders the brand with a unique personality profile. Earlier Levy (1959) argued that people often think of inanimate objects having a gender, age or a class structure. Jennifer Aaker (1997, p. 348) believes that, "similar to personality characteristics, these demographic characteristics are also inferred directly from the brand's user imagery (Aaker)." The use of a celebrity endorser and/or animated characters may also have a personality trait "rub off" effect into the brand (Callcott and Lee, 1994). This may also happen by association through an image transfer process (McCracken, 1988). The country of origin, manufacture or ownership also is considered to contribute to the creation of brand personality (Thakor and Kohli, 1996). In summary the literature suggests that there may be wide range of mechanisms and factors that might drive or indicate brand personality. Other "strategies used by advertisers to imbue a brand with personality traits include: anthropomorphization, personification, and the creation of user imagery" according to Aaker (1997, p. 347).

The original brand personality scale (BPS) developed by Aaker (1995) was initially estimated via a principal components analysis. In this study 631 respondents rated a subset of 37 brands on 114 personality traits. Aaker (1995, p. 76) found a five factor solution that formed the basis for further measure validation. Facets within each factor were then derived by conducting factor analyses on each of the factors. Using facets to further explain the dimensions of human personality is very common (Shaver and Brennan, 1992) and the following facets (in brackets) were obtained for each of the factors after this process: Sincerity (down to earth, honest, wholesome, cheerful); Excitement (daring, spirited, imaginative, up to date); Competence (reliable, intelligent, successful); Sophistication (upper class, charming); and Ruggedness (outdoorsy, tough). This set of 15 components, or "facets", provided further insight regarding the nature of brand personality (Hayes, 1999).

Further analysis (Aaker, 1995) using a confirmatory approach lead Aaker to conclude that brand personality is made up of five first order factors which represent a second order factor called brand personality. Therefore the 42 traits and five factor representation was deemed adequate. Although, some of the development and validation work could be considered inappropriate by some stricter statistical standards, especially within the covariance structural equation modeling testing domain (see Byrne, 2001; Hu and Bentler, 1999), Aakers work was regarded by many as ground breaking.

Other studies within the brand personality field have also utilised reflective research analysis approaches as undertaken initially by Aaker (1995). For instance Strausbaugh (1998) when applying the Adjective Checklist (ACL) and the Myers-Briggs Type Indicator (MBTI) to a brand personality context utilised exploratory factor analysis and confirmatory factor analysis methods which normally assume reflective measures. Cross-cultural replications and alternative uses of the Aaker brand personality scale have used similar analysis methods (Aaker, Benet-Martinez and Garlolera, 2001; Bromley, 2000; Davies, Chun and da Silva, 2001; Caprara, Barbaranelli and Gianluigi, 1998; 2001; Deane, Smith and Adams, 2003; Hayes,

1999; Kim, Han and Park, 2001; Merrilees and Miller, 2001; Venables, Rose and Gilbert, 2003 to name a few). Phau and Lau (2001) in one application developed a 'brand personality index'. In describing this they observed that "the BPS (Brand Personality Scale) was developed based on the mean of all the brand facets (for perceived brand personality) obtained from each respondent (Phau and Lau, 2001, p. 435). However, they did not indicate whether or not they treated indicators as formative indices via construction. As noted earlier, decisions on the assumed measurement orientation (reflective/formative) need to be addressed prior to questionnaire construction and the selection of an appropriate analysis method in such studies.

2.3 Human Personality

In the human personality research domain Raykov (1998) has stated that perfect covariance structural equation model fit is very unlikely as it will not explain or contain all of the relevant variables given the extreme complexity of the phenomena under investigation. However, the work has not taken into account the possibility of a formative specification. It followed the conventional practice within the human personality literature and applied data analysis techniques [exploratory factor analysis (principal components analysis) and confirmatory factor analysis] which generally assume reflective item specification.

Numerous scales have been utilised to measure human personality. The assessment of human personality is often based on traits (Wiggins and Pincus, 1992) and the number of factors within human personality models vary between four and eight constructs (Goldberg, 1990; Zuckerman, Kuhlman, Joireman, Teta, and Kraft, 1993). The five factor model or "The Big Five" is the basis for most modern personality measures (Digman, 1990) and the NEO Personality Inventory is the most closely related to the "five-factor" model (Costa and McCrae, 1989). Cross-cultural studies have also affirmed the five-factor model (Stumpf, 1993). The main five-factor constructs include: Agreeableness, Openness, Conscientiousness, Extraversion, and Neuroticism. The first three constructs correspond quite well with the first three constructs (Aaker, 1995) derived for brand personality (Sincerity, Excitement and Competence). This may partly reflect the fact that Aaker (1995) developed her measures with "The Big Five" (Norman, 1963) as being central to the content domain covered. Human personality research has not always revealed clean solutions. For instance, a personality study by Digman (1992) on "The Big Five" has suggested that high correlations obtained from child, adolescent, and adult samples, imply the presence of two higher-order factors.

Most personality research is typically represented by low correlations between facets or items (Ferrando Chico, 2001; Goldberg, 1990). This has caused personality researchers to review whether confirmatory factor analysis methods are useful at all in this domain (Macrae, Zonderman, Costa, Bond and Paunonen, 1996). Such low intercorrelations may raise questions about the unidimensionality of the human personality traits. The qualitative tests outlined by Jarvis MacKenzie and Podsakoff (2003) would suggest that such occurrences indicate that the measures could be formative in nature. Ozer and Reise (1994) in an excellent review of contemporary personality assessment summarise some of the major strengths and weaknesses of current personality theory. They demonstrate that some components could possibly

be emergent (formative) and state that some of these constructs may not be best represented from an additive component perspective. In fact, they raise the prospect of traits possibly being emergent in nature “that arise from configural, nonadditive, and nonlinear combinations of components (p. 364)”. This view underlines the need to investigate the reflective/formative issues in a more comprehensive fashion.

Given that human personality research is forty years more advanced than brand personality research, it is not surprising that issues have been explored in more depth.

2.4 Brand Relationship Quality

Barwise (1995, p. 47) observes that “increasingly, firms are identifying customer relationships as among their most valuable assets.” Other researchers echo this view and focus on the consumer brand relationship issues stating that “research into brand relationships has the potential to inject new life into the way we think about brands and it offers a language for this consumer experience of brands to ad creatives and marketers”(Melser and Ringham, 1998, p. 8).

Until recently there has been no accepted way to measure quantitatively the person-brand relationship. However, Fournier (1994, 1998) through the use of grounded theory methods and ethnographic techniques qualitatively illustrated that people in fact do have relationships with brands. She found that brands are given animate qualities by their users which further supported the notion of people sustaining dyadic relationships with brands and projecting animate human-like qualities onto inanimate branded objects. Further, qualitative work by Andreou (1994), Hanby (1999), and Hess (1999) has argued that consumers are able to form active and reciprocal consumer-brand relationships, again supporting the validity of the brand-relational metaphor. Understanding consumers and the relationships they form with brands provides knowledge about the enduring bonds that develop between a consumer and brand. It appears that some of these relationship and brand loyalty affiliations are developed from childhood (Ji 2002).

Fournier (1994) developed an item battery to measure the quality of the person-brand bond. She termed this Brand Relationship Quality (BRQ) and described it as “best thought of as a customer-based indicator of the strength and depth of the person-brand relationship. It reflects the intensity and viability of the enduring association between a consumer and a brand (Fournier, 1994, p. 124)”. Fournier (1994) considers the multi-faceted measure of brand relationship quality to be “a refined articulation of the brand loyalty notion”. David Aaker (1996, p. 167) reemphasises this point by stating that, “the dimensions can be viewed as variants of brand loyalty”. The notion of what BRQ is (and what it is not) is best expressed by a direct quotation from Fournier’s (1994) seminal dissertation work:

“Several fundamental principles apply to the brand relationship quality construct which also, serve to differentiate it from existing marketing constructs (such as brand loyalty, satisfaction, etc):

(1) *BRQ is a property of the relationship between a person and a brand.* BRQ is not a characteristic of either the individual or the brand per se, but rather reflects an aspect of the intersection or joining of the two parties.

(2) *BRQ is dynamic;* it changes as a function of time in line with evolution in relationship partners and in response to specific behaviors enacted by them in the context of the relationship. Static measures of BRQ identify characteristics of the relationship at a given point in time. This research measures the person-brand relationship at one point in time. The results presented represent a cross-sectional measurement of the person-brand relationship. However, it must be acknowledged that this person-brand relationship is continually evolving and developing over time.

(3) *BRQ is defined as perceived by the individual in the relationship;* it is reflected in the thoughts, feelings, and behaviors exhibited by the person toward a particular brand and is not an objective characteristic of the brand relationship (as with statistical quality control measures of product performance, for example) (Fournier, 1994, p. 125).”

Using confirmatory factor analysis techniques on a calibration (n=270) and validation sample (n=209), brand relationship quality was revealed to be a second order construct with seven reflective first order constructs. Subsequent work reported by Fournier (1998) revealed that the constructs were: brand partner quality, love and passion, intimacy, self-connection, nostalgic connection, interdependence and commitment. The reflective conceptualisation is consistent with the fact that constructs are measured with typical attitudinal items (Fornell and Bookstein, 1982). A sample of questions from the commitment construct supports this view since they include the statements: “I am willing to make small sacrifices in order to keep using this brand; I would stick with this brand even if it let me down a time or two; and I feel compelled to stick with this brand because of what I’ve invested in it over time.”

BRQ in this study is treated as a reflective second order construct based on the validation work of Fournier (1994). Given that there have been no other studies to date within the marketing literature and within parent disciplines that have raised doubts as to these reflective/formative measurement concerns we will not be applying the vanishing tetrad test to this domain of the structural model.

2.5 The Need for Research into the Directionality Aspect

Until recently, researchers have not had the requisite theory and measures to adequately explore the contribution of softer, intangible, emotional drivers such as brand personality on brand loyalty. Fournier (1998) has specifically called for research investigating the relations between brand personality and brand relationship quality. Netemeyer et al. (2004, p. 222) have echoed this sentiment stating it “is unclear whether brand personality affects some Consumer Based Brand Equity facets”. David Aaker (1996, p. 165) makes a strong case for investigating specific relations between brand personality and brand relationships when he states, “brand behavior and imputed motivations, in addition to affecting brand personality, can also directly affect the brand-customer relationship.” This study addresses the call for research in this area.

The basic structural linkages between the brand personality and brand relationship quality constructs is shown in Figure 2 with the dependent variable (Y) being brand relationship quality and the predictor (X) variables being the brand personality dimensions. Both separate measurement models (Brand Personality and Brand Relationship Quality) feature relationships at a higher level of abstraction. This structure is consistent with each of original individual theory conceptualisations and is the most accepted model of joining the two theoretical domains together.

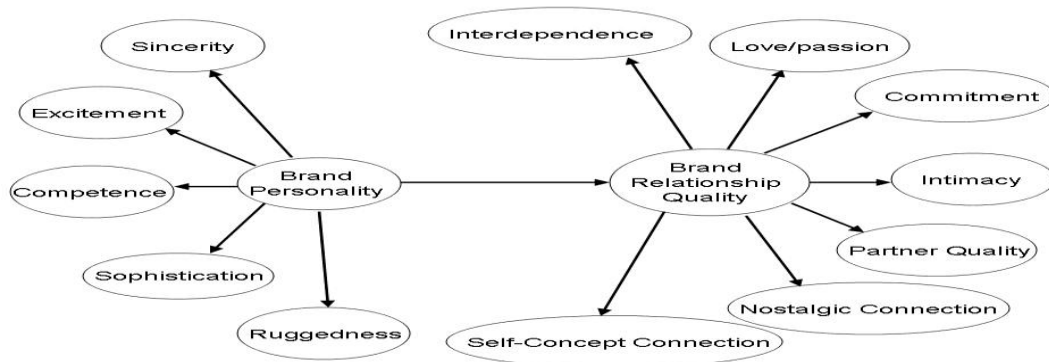


Figure 2: Original Hypothesised Structural Model

However, for some of the main constructs under investigation it is apparent that some doubt exists over the directionality of the trait descriptors for brand personality. They may be viewed as being either reflective or formative (at the item-to-construct level and at the construct to construct level). This doubt has been raised by the literature specifically in the human personality domain. The brand personality representation as has been previously constructed is typical of Type I structures in Figure 3. The vanishing tetrad is designed to test at the item-to-construct level to help in determining whether or not the directions shown in the alternative Type II, III and IV forms are possible representations for brand personality.

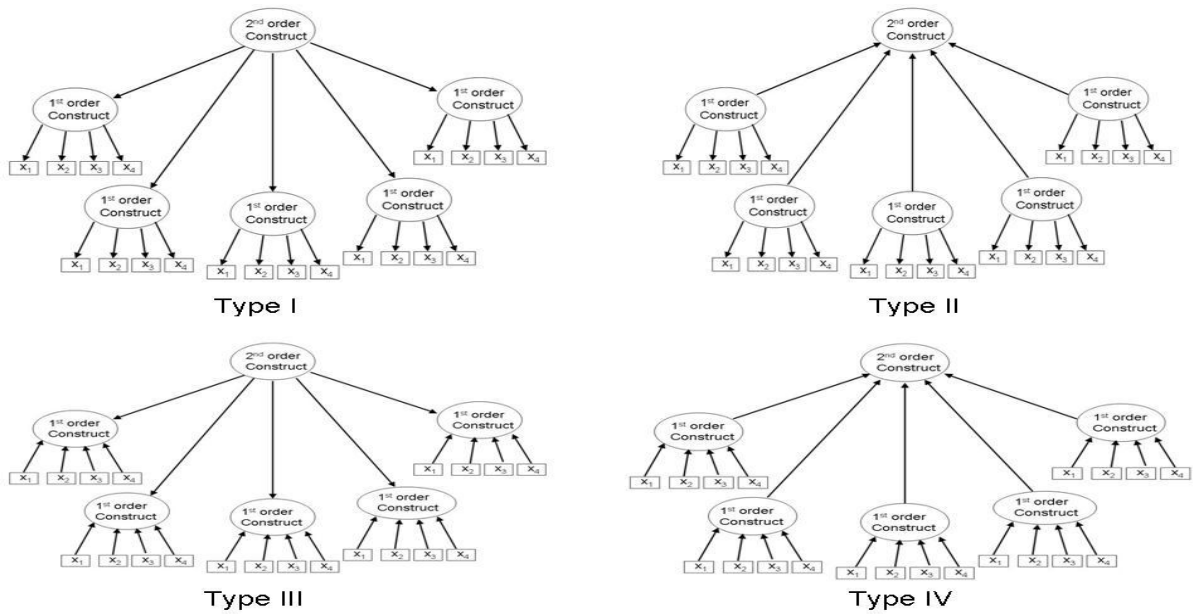


Figure 3: Alternative Second Order Construct Specifications (adapted from Jarvis, MacKenzie and Podsakoff (2003))

The tetrad test applied to the structural model determines whether the measures are reflective or formative between the first order construct representations (Bollen and Ting, 2000) so that the direction of the sincerity, sophistication, excitement, competence and ruggedness factors and the higher order brand personality representations can be fully understood. Figure 4 is the alternative structural model to be tested suggested by the literature. This is in contrast to the more generally accepted model in Figure 2. Given the doubts raised within the person personality domain the tetrad analysis allows testing of the directionality concerns in a more data driven way. In this paper it is only applied to the brand personality measurement models but this full model is given to provide the overall context.

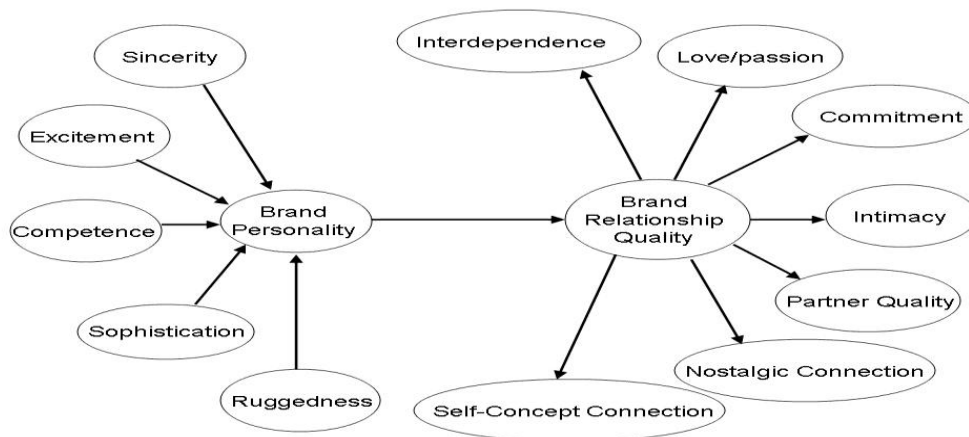


Figure 4: Alternative Hypothesised Structural Model

As MacKenzie, Podsakoff and Jarvis (2005, p. 712-713) observe “given the difference between formative and reflective measurement models, it is important for researchers to carefully evaluate the nature of the relationships between their constructs and measures”.

3. Methodology

The data was collected via a national random mail self-completion questionnaire using Marketing Pro (a national white pages directory with addresses) as the sample frame. Marketing Pro is a CD ROM directory consolidating some 7 million residential listings, Australia wide. The product categories were selected after four pre-tests were completed involving expert opinion, two studies of undergraduate student product class mentions and another study analysing awareness and equity scores from a national survey of brands (Callaghan and Wilson, 1998). The final categories (and brands) chosen also considered such issues as: the product class having national distribution, product class familiarity, and whether the final product classes selected would provide a mix of different involvement levels. The selection was also mindful of previous brands studied (Fournier, 1994). The product classes (and brands) studied included: Cola Soft Drinks (Coca-Cola and Pepsi), Film (Kodak and Fuji), Airlines (Qantas and Ansett), Credit Cards (Mastercard and Visa), Cars (Ford and Holden), and Athletics Shoes (Nike and Reebok). Respondents completed the questionnaire for two brands. The brands are all large and familiar to respondents.

Since the brands are all well established it could be assumed that they might have well defined brand personalities. We would also expect, given the scope and range of the target markets for the brand offerings that they would be multi-faceted and stand for multiple brand personality traits rather than have a single dimensional basis. For example, a brand such as Levi's which has product variants directed at very diverse demographics and various product styles and distribution points. Its brand personality may be linked to notions of masculinity, ruggedness, rebelliousness and individualism. This arises because different offerings such as the Engineered Levi's range are very distinct from others such as the range of Levi's 501's directed at those over 40 years of age. Over time the collection of traits delivered across multiple media executions to various segments covering the different product ranges produce the brands' holistic brand personality and this is considered to represent brand personality strength in this study. This is captured in the higher level construct developed by Aaker (1995) when modelled as a second order construct.

Two main item batteries (Brand Personality Scale: 47 items, Brand Relationship Quality Scale: 62 items) were used.¹ The Brand Personality Scale of Aaker (1995, 1997) was adapted slightly by extending it. In deciding to add items, a panel of experts consisting of three marketing academics reviewed the items to determine their relevance to the Australian culture. The panel was briefed on each construct representing brand personality and discussed the nuance of each trait descriptor with reference to its suitability to the Australian culture. It was considered that Australian respondents would not take out the same meaning from items such as: “western” and “small town”. There was also consensus that the sophistication trait descriptors were not clear enough and the items “sophisticated” and “outback” were added. In line with the original research the Brand Personality Scale was measured

on a 5-point modified Likert scale (not at all descriptive—extremely descriptive). A Likert scale was chosen as the goal “was to determine the extent to which a brand can be described by certain human characteristics (i.e. the strength of a brand’s personality as well as its content), rather than determining when brands are associated negative vs. positive personality characteristics (i.e. the valence of a brand’s personality)” (Aaker, 1995, p. 75).

The Brand Relationship Quality Scale implemented within this study was slightly different to the original scale developed within Fournier’s (1994) dissertation work. Fournier supplied an extended version that was being subjected to further scale validation in ongoing researchⁱⁱ. This version of the BRQ scale was conceptually discussed in Fournier (1998) and is used in this work. There were no significant changes between the two versions. Some constructs had benefited from the rewording of items and the introduction of a few new items. The items used a 7-point scale which was increased from the 5-point scale in Fournier’s (1994) original BRQ scale to allow greater discrimination. The scale was a modified Likert scale (Does not describe my feelings toward the brand at all – Does describe my feeling toward the brand very well). The same panel of experts was also used to assess the potential for item misinterpretation. There were no underlying concerns with the BRQ item battery

A final sample size of 1290 respondents Australia wide was obtained with a final response rate of 25.8% based on a lottery incentive (similar to Aaker, 1995) to encourage response. The questionnaire was mailed out with two reminder letters. Reminder letters were sent out when the responses received had reached a plateau and were starting to decline. An analysis of the sample characteristics indicated that the sample was representative of the Australian population. The distribution of the age of respondents revealed that: 22% were aged 15-34, 51% were aged 35- 54 and 27% were aged 55-75.and the gender split was 53% males and 47% females. Again this mirrored roughly the breakdown within Australian society. Respondents indicated they had a high level of knowledge and familiarity of the brands and around 43% of total respondents had purchased the brands under study in the past year and 68% had at least bought and used the brand at some time in their life.

The analysis of the measurement models used Partial Least Squares (PLS) path modeling. Diamantopoulos and Winklhofer (2001, p. 274) praise the ability and flexibility of PLS in dealing with both reflective and formative measurement model, whilst querying “whether the sheer availability of software for covariance structure analysis (e.g., LISREL, EQS, AMOS) has resulted in an almost automatic acceptance of reflective indicators in the minds of researchers”. Ozer and Reise (1994, p. 365) warn that “(C)aution should be used before viewing structural equation modeling as the statistical representation of choice for multifaceted constructs”. The advantages of utilising PLS are numerous. PLS is considered capable of explaining complex models (Chin, 1998b; Fornell and Bookstein, 1982) and practically always converges (Wold, 1981, 1982). PLS is robust against deviations from the normal distribution (Dawes, Lee and Dowling, 1998; Cassel, Hackl and Westlund, 1999). PLS also overcomes the factor indeterminacy problem of CBSEM and it is easier to derive latent variable scores (Fornell and Bookstein, 1982), can deal with smaller sample sizes (Wittingslow and Markham, 1999), is

better able to cope with formative measures (Fornell and Cha, 1994), and does not rest on the assumption of observation independenceⁱⁱⁱ (Falk and Miller, 1992).

In the analysis we implemented the Vanishing Tetrad SAS macro for the brand personality construct to consider the viewpoint in the literature on human personality that a formative structure could be the basis instead of the more commonly assumed reflective structure. Bollen and Ting (2000) recommend this data driven approach which uses an input matrix derived from LISREL or AMOS.

4. Results

4.1 Preliminary Analysis

The preliminary data analysis involved missing value analysis and descriptives analysis. A test to determine the randomness of missing data was conducted (Hair et al., 1995). The data set was recoded with missing values being coded zero and non-missing values being coded one. A correlation matrix was then run with low correlations indicating a low association between the missing data process for pairs of variables. All correlations were suitably low to suggest the missing data imputation could be considered appropriate. A process of EM imputation was undertaken and, given that this research involves modeling with higher order constructs, replacing with the EM estimated value is believed to have a minor effect on variables undergoing further analysis in the structural model compared to a mean replacement approach (Aiken and West, 1991)^{iv}.

Variable distributions were then examined and it was found that the normality assumption was violated with the variables having a positive skew which is not uncommon with social science data. This non-normality of the data made the usage of PLS more appropriate.

Common method bias can arise when using similar scales with the same number of response options and be exacerbated as higher order constructs for the main measurement models are represented by components measured in a similar format. A factor analysis test revealed that there was no common factor loading on all measures (Podsakoff and Organ, 1986) and therefore common method bias was considered not to be a problem with this dataset.

4.2 The Measurement Models

Before the vanishing tetrad modeling is undertaken we proceeded to investigate issues of unidimensionality and validity assuming a reflective orientation^v. The modeling strategy employed is partially related to the two-step approach advocated by Anderson and Gerbing (1988). The separate measurement models are assessed for adequate validity and unidimensionality prior to commencing the vanishing tetrad tests.^{vi} For this study, the two-step approach involves: (1) a detailed assessment of the measurement models at the item level and higher-order level, and (2) includes an analysis of the posited structural relationships. Reliability and validity was verified for each measurement model at both stages. We follow the recommendation of Chin (1998b) who believes that validity testing for a second order factor model should follow the same process that is used to examine the validity of first order factors.

During this stage of the process we reassess the formative/reflective conditions at this higher order level of abstraction.

In the first step, exploratory factor analysis (EFA) and reliability analysis (RA) to assess the validity of the model measures for each construct are completed. Once this was undertaken implied covariance matrices for each unitary construct measurement model can be estimated in AMOS/LISREL. These derived matrices are the required input into the Tetrad SAS macro. In the second step, the measurement model estimated in step one is used to simultaneously estimate two separate hierarchical measurement models. The internal consistency of the measures, i.e. their unidimensionality and reliability, were the first properties to be assessed. The indicators used to measure a construct (or latent variable) must be unidimensional. Convergent validity for the measures was assessed by running a separate factor analysis for each construct under investigation. This follows the procedure adopted by many researchers utilising PLS in recent times (Bontis, 1998; Grace and O'Cass, 2003, 2005). The analysis is undertaken to confirm that one dimension represents each reflective construct, thus determining if each construct can be regarded as unitary. Each construct was explored via EFA with varimax rotation. EFA is used extensively within consumer research (Baumgartner and Homburg, 1996). The initial analysis indicated that the items of each construct were loading appropriately. Falk and Miller (1992) suggest that loadings of indicators on constructs need to be greater than 0.55. They believe this level is adequate to establish item reliability. Chin (1998b, p. 325) believes, "loadings of .5 and .6 may still be acceptable if there exists other indicators in the block for comparison." The Chin (1998) recommendation is adhered to here as each construct has multiple measures. Most of the loadings (item reliability) exceeded the more stringent cut-off threshold (0.707) which implies that more than 50 per cent (0.707^2) of the variance in the observed variable is shared with the construct (Barclay et al., 1995). The remaining loadings satisfied the Chin (1998) requirement of being greater than 0.6. Three items were eliminated in this process. Correlations between the construct where also inspected and illustrated that items correlated more highly with like items. The item-level EFA results and correlation matrix is not presented so as to preserve space.

Table 1 presents key statistics such as: Cronbach's Alpha (Cronbach, 1951), Construct Reliability [often referred to as Internal Consistency (IC) statistic or Dillon-Goldstein statistic or Maximised Reliability] (Werts et al. 1974) and the Average Variance Extracted (AVE) (Fornell and Larcker 1981) for each construct.

Table 1: Reliability and validity of the reflective first order constructs

Construct	Original No. of Ind ^a	After No. of Ind ^b	Item Loading (λ) Range ^c	Alpha ^d (α)	Const Rel ^e (ρ_{χ})	AVE ^f
Brand Personality						
Sincerity (SIN)	12	11	0.699 → 0.806	0.9309	0.9410	0.5946
Excitement (EXC)	12	12	0.657 → 0.809	0.9259	0.9369	0.5538
Competence (COMP)	9	9	0.645 → 0.837	0.8986	0.9181	0.5554
Sophistication (SOP)	7	7	0.710 → 0.843	0.8977	0.9200	0.6202
Ruggedness (RUG)	7	7	0.602 → 0.821	0.8460	0.8840	0.5249
Brand Relationship Quality						
Partner Quality (PQUAL)	11	11	0.699 → 0.826	0.9316	0.9419	0.5962
Love and Passion (LOV)	9	9	0.677 → 0.858	0.9288	0.9408	0.6426
Intimacy (INTM)	11	9	0.604 → 0.822	0.8875	0.9108	0.5313
Self-Connection (SCON)	7	7	0.781 → 0.852	0.9227	0.9388	0.6859
Nostalgic Connection (NCON)	7	7	0.640 → 0.822	0.8917	0.9170	0.6081
Commitment (COMM)	9	9	0.704 → 0.847	0.9304	0.9422	0.6468
Interdependence (INTD)	8	8	0.658 → 0.849	0.9213	0.9360	0.6541

a = Original Number of Indicators; b = Number of Indicators After Deletion; c = Highest and Lowest Loading After Deletion; d = Cronbach's Alpha; e = Construct Reliability; f = Average Variance Extracted (AVE).

All construct reliabilities were high ranging between 0.884 and 0.942. These reliabilities provide evidence of unidimensionality and illustrate that the constructs are suitable for further analysis (Hattie, 1985). The AVE illustrates the amount of variance the items share with the construct it purports to measure (Fornell and Larcker, 1981). It is important that the items share more variance with its' measures than with other constructs in a given model. This is the case with AVE's ranging between 0.525 and 0.686. The results demonstrate adequate convergent validity and unidimensionality. Convergent validity was therefore satisfied. The hierarchical measurement models could now be estimated.

As the research involves exploring relationships at a higher level of abstraction each second order measurement model are then estimated separately using the repeated

indicators approach, also known as the hierarchical components model suggested by Wold (Lohmöller, 1989, p. 130-133; Chin et al., 2003). "In essence, a second order factor is directly measured by observed variables for all the first order factors. While this approach repeats the number of manifest variables used, the model can be estimated by the standard PLS algorithm (Reinartz, Krafft and Hoyer, 2003, p. 19)." Standardised latent scores (representing the first order constructs) are saved during this stage of the analysis. The standardised scores are automatically computed in the PLS analysis. These scores subsequently become the observed variables representing the first order constructs in the structural model. Factor scores are frequently estimated and used as input for further statistical calculations (Field, 2005; Hair et al., 1995). Other researchers have used the PLS repeated indicators approach and utilised latent construct scores in further analyses within structural models in recent times (Reinartz et al., 2004; Venaik, 1999; Venaik et al., 2001; Venaik et al., 2005; Zhang et al., 2006).

There were two separate hierarchical measurement models (one for brand personality and brand relationship quality). This tests whether the first order constructs loaded onto their posited second order constructs. The same process that was undertaken before when determining the reliability and validity for the measurement models was applied again. The modeling then involves latent variable scores which effectively become observed indicators representing the first order constructs. EFA analysis was firstly undertaken and this confirmed brand personality, and brand relationship quality as being unitary constructs. Loadings for the components representing the BPS and BRQ construct ranged between 0.879 <-> 0.930 and 0.894 <-> 0.960, respectively.

Table 2: Reliability and validity of the reflective second order constructs

Higher Order Construct Name	Component Name	Loading (λ)	Significance ^a
Brand Personality $\square\square X=$ 0.9761 AVE = 0.8277	Sincerity (SIN)	0.9216	***
	Excitement (EXC)	0.9302	***
	Competence (COMP)	0.9193	***
	Sophistication (SOP)	0.8941	***
Brand Relationship Quality $\square\square X=$ 0.9860 AVE = 0.8788	Ruggedness (RUG)	0.8785	***
	Partner Quality (PQUAL)	0.8944	***
	Love and Passion (LOV)	0.9589	***
	Intimacy (INTM)	0.9188	***
	Self-Connection (SCON)	0.9459	***
	Nostalgic Connection (NCON)	0.9403	***
	Commitment (COMM)	0.9601	***
Interdependence (INTD)	0.9404	***	

a Bootstrapping results (n=500) *** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$ n.s = not significant
 $\square\square X$ = Construct reliability
 AVE = Average Variance Extracted

All loadings and path coefficients between the first order and second order constructs were inspected and significance was assessed via 500 bootstrapped iterations (Efron and Tibshirani, 1993). All loadings were again above 0.6 as recommended by Chin (1998b). All higher level construct reliabilities and AVE's were in the acceptable range. Having computed the latent variable scores an assessment of discriminant validity was initiated. Discriminant validity was satisfied with all correlations between constructs (latent variable scores) being lower than their respective reliability estimates (Gaski and Nevin, 1985; Grace and O'Cass, 2003, 2005; O'Cass and Pecotich, 2005). Parameter results and significance levels are presented in Table 2. It should be noted that although these results are presented together each higher order construct domain was estimated as two separate hierarchical measurement models. The next section presents the results from the vanishing tetrad tests.

4.3 The Vanishing Tetrad Tests.

"Tetrad refers to the difference between the product of a pair of covariances and the product of another pair among four random variables (Bollen and Ting, 2000, p. 5)." A tetrad for four variables g, h, i, j is defined as:

$$\tau_{ghij} = \sigma_{gh}\sigma_{ij} - \sigma_{gi}\sigma_{hj}$$

where σ indicates the covariance between the subscripted variables. A tetrad that is equal to 0 is called a "vanishing tetrad" (Rigdon, 2006). The vanishing tetrad test is confirmatory in the sense that we specify the models to be tested in advance. This was done with 5 separate construct models at the item level and also the construct-to-construct model (see Figure 2). The procedure used followed the steps recommended by Bollen and Ting (2000, p. 5) in (a) specifying the most plausible models of the relationship between indicators and latent variables, (b) identifying the model-implied vanishing tetrads for each model, (c) eliminating redundant vanishing tetrads, and (d) performing a simultaneous vanishing tetrad test. Based on this we first generated the implied covariance matrix through a covariance-based structural equation program [step (a) (Ting, 1995)]. The confirmatory vanishing tetrad test was then run through a SAS macro that automatically performs steps (b), (c) and (d) above. The null hypothesis is that the tetrad is equal to zero. That is, the difference between the product of a pair of covariances and the product of another pair of four random variables is zero. Rejecting this hypothesis would suggest a possible problem with the hypothesised model. A result that fails to reject the null hypothesis would indicate "support to the model that implies vanishing tetrads in the test (Ting, 1995, p. 165)." In other words, a significant result would indicate that there is a formative specification.

Ting (1995) has constructed the SAS macro, called CTA-SAS, which performs the vanishing tetrad analysis. It uses the model implied covariance matrix which is derived from LISREL 8.72 (or AMOS) for the model under test and produces a test statistic similar to an asymptotic χ^2 distribution with degree of freedom equal to the number of nonredundant tetrads tested. This test is based on the input matrix meeting the assumption of multivariate normality. The assumption of multivariate normality is not always met and Hipp, Bauer and Bollen (2005) have recently developed a new revised form SAS macro to take this into account. It utilises the polychoric correlation (PCM) matrix and asymptotic covariance matrix (ACM) derived from PRELIS as well as the implied covariance matrix and is more suitable to categorical data. By using the PCM and ACM it takes into account the ordinal structure of the data in a more accurate way (Joreskog and Sorbom, 1993). We endeavoured to use the new tetrad macro where possible^{vii}. This newer macro also works with continuous data which is the case in our nested tetrad analyses as we are working with derived latent variable scores as the basis for calculating the implied covariance matrices.

4.3.1 Brand Personality Item Level Vanishing Tetrad Test

This subsection presents the vanishing tetrad test results for each item-to-construct model for the brand personality constructs: sincerity, excitement, sophistication, competence and ruggedness. These vanishing tetrad tests were run separately for each construct using the implied covariance matrix estimated using a covariance-based structural equation modeling approach. Significant χ^2 result in this instance would indicate that the model is formative in nature. However the tetrad tests reveals non significant results for: Sincerity $\chi^2 = 0.03$ (44 degrees of freedom, $p=1.00$); Excitement $\chi^2 = 0.02$ (54 degrees of freedom, $p=1.00$); Sophistication $\chi^2 = 0.01$ (14 degrees of freedom, $p=1.00$); Competence $\chi^2 = 0.01$ (27 degrees of freedom, $p=1.00$); and Ruggedness $\chi^2 = 0.01$ (14 degrees of freedom, $p=1.00$). These results clearly support these single construct models being conceptualised in a reflective

manner. This strongly supports our previous measurement model work and use of reliability and validity testing procedures.

We next ran a separate vanishing tetrad analysis for the Brand Personality construct only. We used the latent variables scores derived from PLS as input. The tetrad test with reflective indicators has a $\chi^2=0.01$ with 5df, $p=1.00$. We also conclude that this result supports a reflective modeling orientation. This step-wise analysis provided some evidence that the brand personality construct is a Type I (see figure 3) structure.

4.3.2 Construct Level Vanishing Tetrad Test

This subsection presents the nested vanishing tetrad test results. This nested test is another test that supplements the step-wise analysis and tests the additional tetrads implied by the reflective model. We ran two tetrad analyses for the models diagrammatically featured in Figure 2 and 4. This is similar to the example outlined in Bollen and Ting (2000, p. 17). The vanishing tetrads are estimated within each model. In this instance we applied the Hipp, Bauer and Bollen (2005) SAS tetrad macro for the two models as it automates the comparison of the nested and independent tetrads across the two models. The tetrad test of the model with the reflective indicants (figure 2) has a $\chi^2=255.73$ with 53df, $p<.05$, and the test statistic for the model with formative indicants (figure 4) is $\chi^2=208.88$ with 44df, $p<.05$. These tests illustrate that the fit for both models is quite poor and they do not have satisfactory fit. The χ^2 difference test is the statistic of interest as the formative model is nested within the reflective model.

The χ^2 difference test reveals a $\chi^2_{diff}=46.85$ with 9df, $p<.05$. This highly significant chi-square suggests that the additional vanishing tetrads implied by the figure 2 model reduces the fit of the model noticeably. However, for the nested test the formative model specification cannot be entirely ruled out.

To examine these two models in further detail we estimated them using structural equation analyses with both LISREL and PLS. Bollen and Ting (2000) utilise the covariance-based approach to assist in decision making. The analyst should inspect the parameter estimates and determine whether they are statistically significant. Parameter insignificance may indicate problems with the model. The formative model for the covariance-based structural model was specified based on the suggestions of Kline (2006). The parameter estimates and t-values for the reflective model (figure 2^{viii}) were sound. This is true for all estimates in the covariance-based and PLS analyses^{ix}. All parameter estimates were significant. The corresponding estimates for the formative model (figure 4) revealed numerous insignificant effects from the formative indicants to brand personality in both the covariance-based and PLS analyses. Therefore, these results provide support for the model presented in figure 2 (reflective) to be the preferred specification.

5. Discussion and Conclusion

The vanishing tetrad test showed that our prior conceptualisation for the hierarchical measurement models as a Type I model was partially justified with the tetrad analyses. The single construct step-wise tetrad tests confirmed item measures were not formative. We also established that the brand personality construct is best suited to a reflective specification when analysed as a unitary construct. These conclusions were also supported with the qualitative tests following the conditions outlined by Jarvis, MacKenzie and Podsakoff (2003). Bollen and Ting (2000) recommend using structural modeling to assess the significance of each nomological structure. Given that the nested tetrad analyses raised conflicting results we concluded our analysis by estimating the full structural reflective and formative specifications using covariance-based and PLS methods. Insignificant parameter estimates in the formative model supported the choice of the reflective specification. However, we cannot overlook the results of the nested tetrad test which found that the reflective model reduces model fit. At the same time, based on the balance of the qualitative, step-wise tetrad and structural analyses undertaken we conclude that the reflective specification is the most plausible conceptualisation.

We consider that the vanishing tetrad test should not be used in isolation for making the final decision on whether to model with a reflective or formative orientation. Vanishing Tetrads can be found from formative indicators with near zero covariance which would lead to the incorrect selection of a reflective model (adapted from Venai, Midgley and Devinney, 2004). It is important to recognise these caveats with the test. This provides further support for our approach in using multiple methods in forming conclusions.

As Ozer and Reise (1994, p. 364) observe “whenever one goes beyond the standard linear framework in conceptualizing and modeling traits, new levels of complexity, both theoretical and statistical, are added”. This tetrad analysis has been complex and Hipp et al. (2005) observe that it is quite tedious but would have been difficult to explore with other techniques.

Our work is the first that we are aware of to have investigated these substantive issues in brand personality research using the vanishing tetrad test. This study may also represent the first attempt to apply the tetrad test with results obtained through the hierarchical indicators model in PLS. It is also the first known attempt to apply the tetrad test in a step-wise and nested fashion to investigate higher order relations. In this study we concluded that the appropriate measurement orientation is reflective which is consistent with other brand personality research. However, we would still recommend further replication to provide more conclusive evidence.

Whilst these tests involves considerable programming and advanced statistical skills we believe that considering path directionality is fundamental to theoretical development and measurement validity and recommend other social researchers follow this activity.

There are study limitations concerning the scope (12 brands) and the number of product categories (6 product classes) studied. We recommend future researchers consider other brands within the product category, extending past the two most familiar brands and incorporating lower-level brands (or even niche brands). As the sample size to number of variables ratio was too low, contrasts could not be made

between brands. A larger longitudinal study might also be useful to examine the dynamics of brand personality and relationships. In conclusion, we believe, these results assist future researchers attempting to investigate these two theoretical domains.

References

Aaker, David A 1996, *Building Strong Brands*. Free Press, New York.

Aaker, J L 1995, "Brand Personality: Conceptualization, Measurement and Underlying Psychological Mechanisms." Stanford University, Ann Arbor. *Doctoral Dissertation*.

Aaker, J L 1997, "Dimensions of Brand Personality." *Journal of Marketing Research*. Vol. 34 No. August, 347-356.

Aaker, J L Benet-Martinez, V and Garlolera, J 2001, "Consumption Symbols as Carriers of Culture: A Study of Japanese and Spanish Brand Personality Constructs." *Journal of Personality and Social Psychology*. Vol. 81 No. 5, 492-508.

Aaker, J. and Fournier, S. 1995, "A Brand as a Character, A Partner and a Person: Three Perspectives on the Question of Brand Personality." Kardes, Frank R. and Sujan, Mita., Editors. in *Advances in Consumer Research*. Association for Consumer Research, Provo, UT, 391-395.

Aiken, L S and West, S G 1991, *Multiple regression: testing and interpreting interactions*. Sage, Beverly Hills: CA.

Allen, Douglas E and Olson, Jerry 1995, "Conceptualizing and Creating Brand Personality: A Narrative Theory Approach." Kardes, Frank R and Sujan, Mita, Editors. in *Advances in Consumer Research*. Association for Consumer Research, Provo, UT, 391-395

Anderson, J C and Gerbing, D W 1988, "Structural equation modeling in practice: A review and recommended two-step approach." *Psychological Bulletin*. Vol. 103, 411-423.

Andreou, Philikypros T 1994, "Brand Relationships: A New Approach to Branding." University of South Hampton, United Kingdom. *PhD Dissertation*.

Barclay, D Higgins, C and Thompson, R 1995, "The Partial Least Squares (PLS) Approach to Causal Modeling: Personal Computer Adoption and Use as an Illustration." *Technology Studies*. Vol. 2 No. 2, 285-309.

Baumgartner, H and Homburg, C 1996, "Applications of structural equation modeling in marketing and consumer research: A review." *International Journal of Research in Marketing*. Vol. 13, 139-161.

Barwise, T P 1993, "Brand equity: Snark or boojum?" *International Journal of Research in Marketing*. Vol. 10 No. 1, 93-104.

- Barwise, Patrick 1995, "Marketing Today and Tomorrow." *Business Strategy Review*. Vol. 6 No. 1, 45-59.
- Bollen, Kenneth A 1989, *Structural Equations with Latent Variables*. John Wiley and Sons, New York.
- Bollen, K A and Lennox, R 1991 "Conventional Wisdom on Measurement: A Structural Equation Perspective." *Psychological Bulletin*, Vol. 110 No. 2, 305-314.
- Bollen, K. A & Ting, K. F 1993, "Confirmatory tetrad analysis." In P. Marsden (ed.), *Sociological Methodology 1993* (pp.147-1750). Washington, DC: American Sociological Society.
- Bollen, K. A & Ting, K. F 1998, "Bootstrapping a test statistic for vanishing tetrads." *Sociological Methods and Research*. Vol. 27, 77-102.
- Bollen, K. A & Ting, K. F 2000, "A Tetrad Test for Causal Indicators." *Psychological Methods*. Vol. 5, No. 1, 3-22.
- Bromley, D. B. 2000, "Psychological Aspects of Corporate Identity, Image and Reputation." *Corporate Reputation Review*. Vol. 3 no. 3, 240-252.
- Bontis, N 1998, "Intellectual capital: an exploratory study that develops measures and models." *Management Decision*. Vol. 36 No. 2, 63-76.
- Byrne, Barbara M 2001, *Structural Equation Modeling with AMOS*. Lawrence Erlbaum Associates, New Jersey.
- Byrne, B M and Campbell, T L 1999, "Cross-Cultural Comparisons and the Presumption of Equivalent Measurement and Theoretical Structure: A Look Beneath the Surface." *Journal of Cross-Cultural Psychology*. Vol. 30 No. 5, 555-574.
- Callcott, M F and Lee, W-N 1994, "A Content Analysis of Animation and Animated Spokes-Characters in Television Commercials." *Journal of Advertising*. Vol. 23 No. 4.
- Callaghan W M and Wilson B J 1998, "The Role of the Category in Brand Equity Studies: A Brand Attitudinal Segmentation Perspective." *ANZMAC Conference Proceedings*. 30th November – 2nd December. Dunedin. University of Otago, p 295-312.
- Caprara, Gian Vittorio Barbaranelli, Claudio and Gianluigi Guido 1998, "Personality as Metaphor: Extension of the Psychlexical Hypothesis and The Five Factor Model to Brand and Product Personality Description." *European Advances in Consumer Research*. Vol. 3, 61-69.
- Caprara, Gian Vittorio Barbaranelli, Claudio and Gianluigi, Guido 2001, "Brand personality: How to make the metaphor fit?" *Journal of Economic Psychology*. Vol. 22, 377-395.

Cassel, C M Hackl, P and Westlund, A H 1999, "Robustness of partial least-squares method for estimating the latent variable quality structures." *Journal of Applied Statistics*. Vol. 26 No. 4, 435-446.

Chin, Wynne W 1998a, "Issues and Opinion on Structural Equation Modeling." *MIS Quarterly*. (March), vii-xvi.

Chin Wynne W. 1998b, "The Partial Least Squares Approach to Structural Equation Modeling." in Marcoulides, George A. (Editor) *Modern Methods for Business Research*. Lawrence Erlbaum, Mahwah, NJ, 295-336.

Chin, W W Marcolin, B L and Newsted, P R 2003, "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study." *Information Systems Research*. Vol. 14 No. 2, 189-217.

Chin, W W and Newsted, P R 1999, "Structural Equation Modeling Analysis with Small Samples using Partial Least Squares." in .R. H. Hoyle (Ed.) *Statistical Strategies for Small Sample Research*. SAGE Publications, Thousand Oaks CA. pp. 307-341.

Costa, P T and McCrae, R R 1989, *NEO-PI/NEO-FFI Manual Supplement*. Odessa. Psychological Assessment Research.

Davies, Gary Chun, Rosa and da Silva, Rui Vinhas 2001, "The Personification Metaphor as a Measurement Approach for Corporate Reputation." *Corporate Reputation Review*. Vol. 4 no. 2, 113-127.

Dawes, P L Lee, D Y and Dowling, G R 1998, "Information Control and Influence in Emergent Buying Centers." *Journal of Marketing* Vol. 62 No. 3, 55.

Deane, J Smith, G and Adams, A 2003, "Sports Sponsorship and Brand Personality: The Ryder Cup Team and IBM." *International Journal of Sports Marketing and Sponsorship*. Vol. 5 No. 3, 193-208.

Diamantopoulos, A 2006, "The error term in formative measurement models: interpretation and modeling implications." *Journal of Modelling in Management*. Vol. 1 No. 1, 7-17.

Diamantopoulos, A and Winklhofer, H M 2001, "Index construction with formative indicators: An alternative to scale development." *Journal of Marketing Research*, Vol. 38 No. 2, 269-277.

Digman John M 1990, "Personality structure: emergence of the five-factor model." *Annual Review of Psychology*. Vol. 41; 417-440.

Digman, John M 1992, "Higher-Order Factors of the Big Five." *Journal of Personality and Social Psychology*. Vol. 73 No. 6, 1246-1256.

Dowling, Grahame R 1994, *Corporate Reputations: Strategies for Developing the Corporate Brand*. Longman Professional, Melbourne.

- Efron, B and Tibshirani, R J 1993, *An Introduction to the Bootstrap*. Chapman and Hall, New York.
- Falk, R Frank and Miller Nancy B 1992, *A Primer for Soft Modeling*. The University of Akron Press, Akron, Ohio.
- Ferrando, P J and Chico E 2001, "The construct of sensation seeking as measured by Zuckerman's SSS-V and Arnett's AISS: A structural equation model." *Personality and Individual Differences*. Vol. 31, 1121-1133.
- Field, A 2005, *Discovering Statistics Using Spss*. 2nd Edition. Sage, London.
- Fishbein, Martin and Ajzen, Icek 1975, *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Reading, MA: Addison-Wesley.
- Fornell, C 1992, "A National Customer Satisfaction Barometer: The Swedish Experience." *Journal of Marketing*. Vol. 56 No. 1, 6-22.
- Fornell, Claes and Bookstein, Fred L 1982, "Two Structural Equation Models: LISREL and PLS Applied to Consumer Exit-Voice Theory." *Journal of Marketing Research*. Vol. 19 No. November, 440-452.
- Fornell, C and Cha, J 1994, "Partial least squares." In: Bagozzi, R. P. (Ed). *Advanced Methods of Marketing Research*. Basil Blackwell Ltd, Oxford, pp. 52-78.
- Fornell, C and Larcker, D F 1981, "Evaluation of Structural Equation Models with Unobservable Variables and Measurement Error." *Journal of Marketing Research*, Vol. 18 No. (February), 39-50.
- Fournier, S 1994, "A Consumer-Brand Relationship Framework for Strategic Brand Management." University of Florida, *Doctoral Dissertation*.
- Fournier, S 1998, "Consumers and Their Brands: Developing Relationship Theory in Consumer Research." *Journal of Consumer Research*. Vol. 24 No. March, 343-373.
- Fuller, K 1995, "The Levi 501 campaign." *Admap*. Vol. 349 No. March, 20-23.
- Gardner, Burleigh B and Levy, Sidney J 1955, "The Product and the Brand." *Harvard Business Review*. (March-April), 33-39.
- Gaski, J F and Nevin, J R 1985, "The Differential Effect of Exercised and Unexercised Power in a Marketing Channel." *Journal of Marketing Research*. Vol. 22 No. May, 130-142.
- Goldberg, L R 1990, "An alternative "description of personality": The big-five factor structure." *Journal of Personality and Social Psychology*, Vol. 50, 1216-1229.
- Grace, D and O'Cass, A 2003, "Child care services: An exploratory study of choice, switching and search behaviour." *European Journal of Marketing*. Vol. 31 No. 1/2, 107-132.

- Grace, D and O' Cass, A 2005, "An examination of the antecedents of repatronage intentions across different retail store formats." *Journal of Retailing and Consumer Services*. Vol. 12, 227-243.
- Hair, J F Jnr Anderson, R E Tatham, R L and Black, W C 1995, *Multivariate Data Analysis: with Readings*. Prentice Hall, New Jersey.
- Hanby, Terry 1999, "Brands- dead or alive?" *Journal of the Market Research Society*. Vol. 41 No. 1, 7-18.
- Hattie, J 1985, "Methodology Review: Assessing Unidimensionality of Tests and Items." *Applied Psychological Measurement*, Vol. 9 No. 2, 139-164.
- Hayes, James Bryan 1999, "Antecedents and Consequences of Brand Personality. Mississippi State University." Mississippi. *Doctoral Dissertation*.
- Hess, Jeffrey Scott 1998, "A Multidimensional Conceptualization of Consumer Brand Relationships: The Differential Impact of Relationship Dimensions on Evaluative Relationship Outcomes." University of Colorado, U.S.A. *Doctoral Dissertation*.
- Hipp, J R Bauer, D J and Bollen, K A 2005, "Conducting Tetrad Tests of Model Fit and Contrasts for Tetrad-Nested Models: A New SAS Macro." *Structural Equation Modeling*, Vol. 12. No. 1, 76-93
- Hu, Li-tze and Bentler, Peter M 1999, "Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives." *Structural Equation Modeling*. Vol. 6 No. 1, 1-55.
- Jarvis, C B MacKenzie, S B and Podsakoff, P M 2003, "A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research." *Journal of Consumer Research*. Vol. 30 No. September, 199-218.
- Ji, Mindy F 2002, "Children's Relationships with Brands: "True Love" or "One-Night" Stand?" *Psychology and Marketing*. Vol. 19 No. 4, 369-387.
- Joreskog, Karl and Sorbom, Dag. 1993, *LISREL8: Structural Equation Modeling with the SIMPLIS Command Language*. Scientific Software International., Lincolnwood, IL.
- Keller, K L 1993, "Conceptualizing, measuring, and managing customer-based brand equity." *Journal of Marketing*, Vol. 57 No. 1, 1-22.
- Kleinbaum, D G Kupper, L Muller, K E 1988, *Applied Regression Analysis and Other Multivariate Methods*, 2nd ed. PWS-Kent, Boston.
- Kim, Chung K Han, Dongchul and Park, Seung-Bae 2001, "The effect of brand personality and brand identification on brand loyalty: Applying the theory of social identification." *Japanese Psychological Research: Special Issue Consumer Behavior*. Vol. 13 No. 4, 195-206.

- Kline, R B 2006, "Formative Measurement and Feedback Loops." in .Hancock, G. R. and Mueller, R. O. (Editors.) *Structural Equation Modeling: A Second Course*. IAP-Information Age Publishing , Greenwich., 43-68.
- Levy, S J 1959, "Symbols for Sales." *Harvard Business Review*, Vol. 37 No. 4, 117-124.
- Lohmoller, Jan-Bernd., 1989. *Latent Variable Path Modeling with Partial Least Squares*. Physica-Verlag, Heidelberg, Germany.
- MacKenzie, S B Podsakoff, P M Jarvis, C B 2005, "The Problem of Measurement Model Misspecification in Behavioral and Organizational Research and Some Recommended Solutions." *Journal of Applied Psychology*. Vol. 90 no. 4, 710-730.
- Macrae, R R Zonderman, A B Costa, P T Bond, M H and Paunomen S V 1996, "Evaluating replicability of factors in the revised NEO Personality Inventory: Confirmatory factor analysis versus Procrustes rotation." *Journal of Personality and Social Psychology*, Vol. 70, 552-566
- Marketing Science Institute (2004). *Research Agenda 2004/2005*. Available from <http://www.msi.org>.
- McCracken, G 1988, *Culture and Consumption*. University Press, Bloomington.
- McCrae, R R and John, O P 1992, "An Introduction to the Five-Factor Model and Its Application." *Journal of Personality*. Vol. 60 No. 2, 175-224.
- Melser, Peter and Ringham, Liane 1998, "Brand Relationship Quality (BRQ) Enables Richer Insights into Brands." *Research News*. Vol. 15 No. 9, 1-8.
- Merrilees, Bill and Miller, Dale 2001, "Antecedents of Brand-Personality in Australian Retailing: An Exploratory Study." in *ANZMAC Conference Proceedings.*, Massey University. New Zealand.
- Netemeyer, R G Krishnan, B Pullig, C Wang, G Yagci, M Dean, D Ricks, J and Wirth, F 2004, "Developing and validating measures of facets of customer-based brand equity." *Journal of Business Research*. Vol. 57 No. 2, 209-224.
- Norman, W T 1963, "Toward an Adequate Taxonomy of Personality Attribute: Replicated Factor Structure in Peer Nomination Personality Ratings." *Journal of Abnormal and Social Psychology*. Vol. 66, 574-583.
- Nueberg, Steven L West, Stephen G Judice, Nicole T and Thompson, Megan M 1997, "On Dimensionality, Discriminant Validity, and the Role of Psychometric Analyses in Personality Theory and Measurement: Reply to Kruglanske et al.'s (1997) Defense of the Need for Closure Scale." *Journal of Personality and Social Psychology*. Vol. 73 No. 5, 1017-1029.
- O'Cass, A and Pecotich, A 2005, "The dynamics of voter behavior and influence in electoral markets: a consumer behavior perspective." *Journal of Business Research*. Vol. 58, 406-413.

Ozer, D J Reise, S P 1994, "Personality Assessment" *Annual Review of Psychology*. Vol. 45, 357-388.

Plummer J T 1985, "How Personality Makes a Difference." *Journal of Advertising*. Vol. 24 No. (December/January), 27-31

Podsakoff, P M and Organ, D W 1986, "Self-reports in organizational research: problems and prospects." *Journal of Management*. Vol. 12 No. 4, 531-544.

Raykov T 1998, "On the use of confirmatory factor analysis in personality research." *Personality and Individual Differences*. " Vol. 24, 291-293.

Reinartz, W Krafft, M and Hoyer, W D 2003, "Measuring the Customer Relationship Management Construct and Linking it to Performance Outcomes." *INSEAD Working Paper Series*. 2003/02/MKT, 1-51.

Reinartz, W Krafft, M and Hoyer, W D 2004, "The customer relationship management process: Its measurement and impact on performance." *Journal of Marketing Research*, Vol. 41 No. 3, 293–305.

Rigdon, E 2006, *Tetrad Analysis*. Viewed 12th January 2006.
<<http://www2.gsu.edu/~mkteer/relmeth.html#refs>>

Shaver, Phillip R and Brennan, Kelly A 1992, "Attachment Styles and the "Big Five" Personality Traits: Their Connections With Each Other and With Romantic Relationship Outcomes." *Personality and Social Psychology Bulletin*. Vol.18. no. 5, 536-545.

Sirgy, J M 1982, "Self-Concept in Consumer Behavior: A Critical Review." *Journal of Consumer Research*. Vol. 9 No. December, 287-300.

Strausbaugh, Kirsten Lynn 1998, "Miss Congeniality" or "No More Mr. Nice Guy?" on a Method for Assessing Brand Personality and Building Brand Personality Profiles. University of Florida, USA. *PhD Dissertation*.

Stumpf H 1993, "The factor structure of the Personality Research Form: A cross-national evaluation." *Journal of Personality*. Vol. 61, 27-48.

Thakor, M V and Kohli, C S 1996, "Brand Origin: conceptualization and review." *Journal of Consumer Marketing*. Vol. 13 No. 3, 27-42.

Ting, K. F 1995, "Confirmatory tetrad analysis is SAS." *Structural Equation Modeling*. vol. 2. 163-171.

Venables, Beverly T Rose, Gregory M and Gilbert, Faye W 2003, "Measuring the Brand Personality of Non-Profit Organizations." in *Advances in Consumer Research*. Association for Consumer Research, 379-380.

Venaik, S 1999, *A Model of Global Marketing in Multinational Firms: An Empirical Investigation*. The Australian Graduate School of Management, Sydney. PhD Dissertation.

Venaik, S Midgley, D F and Devinney, T M 2001, "Autonomy, Networking and Interunit Learning in a Model of MNC Subsidiary Innovation and Performance." *AGSM Working Paper*. (May), 1-47.

Venaik, S. Midgley, D. F and Devinney, T 2004, "A New Perspective on the Integration-Responsiveness Pressures Confronting Multinational Firms." *Management International Review*. Vol. 44, 15-48.

Venaik, S Midgley, D F and Devinney, T M 2005, "Dual paths to performance: the impact of global pressures on MNC subsidiary conduct and performance." *Journal of International Business Studies*. Vol. 36 No. 6, 655-678.

Werts, C E Linn, R L and Jöreskog, K G 1974, "Intraclass Reliability Estimates: Testing Structural Assumptions." *Educational and Psychological Measurement*. Vol. 34, 25-33.

Wiggins, J S 1992, "Have model, will travel." *Journal of Personality*. Vol. 60, 527-532.

Williams, L. J Edwards, J R and Vandenberg, R J 2003, "Recent advances in causal modeling methods for organizational and management research." *Journal of Management*, Vol. 29, 903-936.

Wittingslow, G E and Markham, S 1999, "Customer-Driven Modelling of Satisfaction Behaviour." *Australasian Journal of Market Research*, Vol. 7 No. 2, 29-38.

Wold, H 1981, "Model construction and evaluation when theoretical knowledge is scarce: theory and application of partial least squares." in .Kmenta, J. and Ramsey, J. Eds. *Evaluation of Econometric Models*. Academic Press , New York. pp. 47-74.

Wold, H. (1982). Soft modeling. The basic design and some extensions. In: K. G. Jöreskog, & H. Wold (Eds.): *Systems under indirect observation. Causality, structure, prediction. Part I* (pp. 1–54). Amsterdam/New York/Oxford: North-Holland.

Zaichowsky, J. L 1985, "Measuring the involvement construct." *Journal of Consumer Research*, Vol. 12, 341-352.

Zhang, P Li, N and Sun, H 2006, "Affective Quality and Cognitive Absorption: Extending Technology Acceptance Research." In *Proceedings of the 39th Hawaii International Conference on Systems Sciences*. IEEE Computer Society, 11p.

Zuckerman, M Kuhlman, D M Joireman, J Teta, P and Kraft, M 1993, "A comparison of three structural models for personality: The big three, the big five, and the alternative five." *Journal of Personality and Social Psychology*. Vol. 65, 757-768.

End Notes:

ⁱ There are a total of 109 possible items (ignoring item deletion) in the main effects model. This in itself is a complex model. Conventional sample size rules of a minimum of at least five observations per item is often recommended [e.g.,(Tabachnick and Fidell, 1996)], and a ratio of ten or greater is preferred.

ⁱⁱ The first author would like to acknowledge and thank Professor Fournier for her initial support, inspiration and for supplying the most up to date BRQ scale for investigation.

ⁱⁱⁱ Marketers often carry out attitudinal studies and run the same item battery sometimes repeatedly for the same individual. Data is often then stacked for analysis. Eg. Each respondent rates five brands on the same scale (Aaker, 1995).

^{iv} Given that the structural modeling of higher-order constructs utilises derived factors scores representing first-order constructs the series mean would have minimal impact on the derived factor scores compared with other imputation methods. Factor scores when derived are standardised. PLS analyses also were implemented with mean replacement of the missing data and there are no discernable differences between results.

^v Typically the Vanishing Tetrad Test is completed as the first stage in an analysis at the single construct level. Given that we are running two hierarchical higher-order measurement models and are also applying the tetrad test to this level of abstraction we decided to present both the single construct and structural model tetrad tests together. This allowed for presentation simplicity. Also, although we calculated our PLS measurement models prior to running Tetrad analyses you will notice that the item deletion at the single construct level is minor. One item in the brand personality construct Sincerity was deleted. Given this we did not consider this a problem in running and presenting the tetrad results second. However, if the Tetrad test establishes that the constructs may be better explained by a formative structure then all previous tests establishing unidimensionality and validity in the reflective orientation would be considered inappropriate as these tests are not suitable for formative indicants (MacKenzie, Podsakoff and Jarvis, 2005). This caveat should be kept in mind.

^{vi} In principle, the goal is the same to establish adequate construct validity and unidimensionality, however, the process is slightly different when undertaking a two-step approach with PLS. With covariance-based methods goal is to create adequate congeneric measurement models with the aim of reducing the number of indicators (item purification) and then to create composite single indicators proportionately weighted by each item factor score. The second stage in covariance-based methods involves evaluating the structural model taking these composite single indicators and fixing paths and error variances by formula (to allow model identification). The researcher then can estimate the coefficients of posited structural relations and discuss in relation to previous hypotheses.

^{vii} In some instances due to the use of the EM algorithm when dealing with missing data PRELIS would not calculate the PCM and ACM as there are greater than 15 response categories. The software automatically treats the data as continuous.

^{viii} Errors terms and fixed parameters for correct identification are excluded from the visual figure presented in this article but were present within the actual analyses.

^{ix} The similarity in structural parameter estimates BPS → BRQ for the reflective structural model is remarkable ($\beta = 0.612$ LISREL; $\beta = 0.601$ PLS). This is a difference of 0.011 and is typical of PLS bias in slightly underestimating the structural parameter values due to the “consistency at large” bias (Fornell and Cha, 1994). Maximum likelihood estimation was utilised.