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Product creativity: conceptual model, measurement and characteristics

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This study investigates the composition of product creativity by examining elements of consumer products from the consumer's perspective. This study presents a conceptual model of product creativity assessment within the context of the information processing model. A product creativity survey of 52 items, based on the Creative Product Analysis Matrix and the literature findings, was completed by 205 university students. Results of an exploratory and confirmatory factor analysis indicated six main product creativity dimensions and the percentages of the total variance accounted for by each dimension, which are: resolution (27%); emotion (9%); centrality (8%); importance (8%); desire (7%); and novelty (6%). Results of a stepwise regression indicated that these three product creativity dimensions (centrality, importance and desire) significantly predict customer satisfaction (40% of the explained variance) and purchasability (33% of the explained variance) of creative products. The study concludes with related implications to enhancing product creativity.

Keywords: Product creativity dimensions and measurement; Information processing; Factor analysis

1. Introduction

Throughout history, creative products such as the light bulb, the computer or the mp3 player have often been credited with providing beneficial changes, expanding markets and impacting behaviours and attitudes within society. However, many products that people called creative yesterday are not considered as creative today. At first glance, product creativity appears to be not only subject to the person who is judging the product but also subject to when and where the product exists. This confusion has deterred research from making progress in understanding the dimensions, measurement and impact of product creativity. Some research argues that product creativity cannot be defined, but only exists if appropriate judges agree that it exists (Amabile 1983). This approach, however, does not lend itself to fully understanding and exploring the impact of product creativity on consumer behaviours such as willingness to purchase and customer satisfaction.

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Current research has stressed the importance yet lack of appropriate measures of product creativity (Alber and Runco 1999, Mayer 1999, Christiaans 2002). The Creative Product Semantic Scale (CPSS) (Besemer and O'Quin 1986, 1987, 1999, O'Quin and Besemer 1989, 1999, Besemer 1998) measures product creativity from the scores of three dimensions (novelty, resolution and style); each dimension is assessed with 15–20 semantic pairs. The Consensual Assessment Technique (CAT) (Amabile 1983) is a subjective assessment of product creativity, where judges are asked to individually select and score criteria to determine the product creativity. A recent study by Christiaans (2002) that compares these two measurement tools reveals that both are limited in application and utility for determining product creativity. The overall arguments against the CAT include time-demand impracticality, lack of appropriateness for individual differences or cutting edge technology and high correlation with other factors. The CPSS main weaknesses are found in the instrument's vague definition of creativity and its lack of criteria to assess creativity as well as questionable validation techniques.

Thus, the primary focus of this study is to develop a tool to measure the consumer-based assessment of product creativity. The main purpose of this study is not to maximize the effectiveness of the product creativity, but to validly characterize and measure product creativity from the consumers' perspective. The objective is to construct and validate an instrument that captures consumers' perceptions of product creativity then to evaluate the contribution of product creativity to product purchasability. This tool will utilize the strengths of current methods of capturing perception of product creativity and expand with a more extensive measurement structure based on consumer perceptions of product design. The tool would be validated through broader product classes testing and predictive measures of consumer attitude. A validated instrument that measures product creativity also provides a tool to evaluate the relationship between creativity and consumer attitudes such as purchase intentions and consumer satisfaction.

In order to obtain an encompassing measurement tool, a conceptual model is first developed that incorporates the theory and knowledge of creativity, the product development process and consumer perception and behaviour. Thus, in combination, these perspectives more fully encapsulate consumers' views of product creativity than taken alone. Only by first clearly defining product creativity and the associated dimensions can a valid model and measurement tool be developed and utilized to investigate the role of product creativity in consumer behaviour. The study begins by describing the framework including assumptions and constraints that are the basis of the definition, dimensions and conceptual model of product creativity.

2. Framework

2.1. Assumptions

The following three major assumptions are taken for this study. First, product creativity is a subjective judgement or assessment that a person asserts towards an object. Product creativity is not solely an objective or physical attribute of the product, but is dependent on the judge and context in which the product exists. Therefore, product creativity only exists if there is a judgement of a product

(based on a set of criteria) and products cannot be inherently creative (without judgement).

Secondly, a universal set of criteria for the judgement of product creativity exists. The overall level of product creativity comes from an assessment of each creativity criterion. Each criterion in the set as well as the overall judgement of product creativity is evaluated on a continuum that is comparable across products. The judgement that a product is not creative occurs if the product does not exhibit one or more of the criteria. A product judged to be highly creative exhibits high levels of each criterion. To maximize product creativity would be to maximize the assessment of all criterion levels. Judgement of the criterion levels is dependent on the judge's experience and societal background, including the judge's understanding and past involvement with the product, the context in which the product is judged and the context in which the product may be used.

The set of criteria used to assess product creativity is not assumed to be a required part of the overall product evaluation for all product types. The assessment of product creativity (from the assessment of the creativity criteria) may or may not be part of overall product evaluation and may or may not occur for all product types. However, the assessment of product creativity is assumed to be a possible criterion and is assumed to have a zero to positive influence in overall product evaluation for all product types. In other words, product creativity may or may not be a criterion for product evaluation, but when creativity is considered to be a criterion the assessment has a neutral to positive influence on the overall product evaluation. Therefore, product creativity is assumed to have the potential to be an added value to product evaluation for all product types.

2.2. Constraints

This study constrains the existence of product creativity to depend on the interactions between products, consumers and society. Using Csikszentmihalyi's (1988, 1999) systems theory of creativity, consumer product creativity is said to be a result of the interactions between creators, society (judges of creation) and context (the product and judge domain). The combination of interactions results in judgements of creative products. Based on this theory, product creativity exists through the connection between the producer and consumer, specifically through the interaction between the product and the consumer. The context or domain transmits information (through rules and practices) to the producer and the consumer about the product design. Therefore, the judgement of product creativity is constrained to the interactions between the product, consumer and domain.

This study also constrains the model of product creativity evaluation by limiting the judge's ability to evaluate product creativity. This research is primarily concerned with consumer products, thus product form and function are two major components of the product evaluation. This research specifically addresses the visual inspection of consumer products in relation to the evaluation of product creativity, namely from two-dimensional images, as compared to evaluating three-dimensional products through physical interaction with the product. Thus, the comprehension of product creativity is limited to the judge's experience with the product functions and understanding of the functionality from visual perception of the product. The evaluation of creativity is also limited by the judge's understanding of the product

form from visual perception. Therefore, the evaluations of product creativity in this study are constrained to the visual comprehension of product form and function.

In sum, three major assumptions and the explained constraints provide the framework for the conceptual model. The conceptual model will be explained below by first defining the construct of product creativity addressed in this study, then describing the dimensions of the construct and finally illustrating how the dimensions fit into an information processing model of product creativity assessment.

3. Model description

3.1. Definition of product creativity

Based on research involving creativity, product development and consumer behaviour, this study defines product creativity as the subjective judgement of a product to exhibit novelty and appropriateness that elicits arousal and pleasure and is compatible with the judge's preferences. To be a creative product, the product must be judged to exhibit some level of novelty and some degree of appropriateness. To be a creative product, the judge must experience some level of pleasure and arousal from the product interaction. And, finally, to be a creative product, the product must be to some extent compatible with the judge's preferences. From this definition, seven dimensions of product creativity can be explained and supported by literature.

3.2. Dimensions of product creativity

The definition of product creativity adopted for this study is broken down into seven dimensions, which fall into three major types of dimensions: product attribute dimensions, affect dimension and preference dimensions (see table 1).

The first part of the definition considers product creativity in terms of the novelty and appropriateness of the product attributes. Appropriateness consists of both product resolution (the product's usefulness) and product elaboration and synthesis (the product's style). Thus, the first three dimensions of product creativity are defined as novelty, resolution and elaboration and synthesis. As previously described, the Creative Product Analysis Matrix defines these dimensions as the

Table 1. Aspects and dimensions of product creativity.

Aspect	Definition	Dimensions	References
Attribute	The perception of product creativity	Novelty, Resolution, Elaboration and Synthesis	Besemer and Treffinger (1981), Besemer and O'Quin (1986, 1987, 1999), O'Quin and Besemer (1989, 1999), Besemer (1998)
Affect	The emotional impact of product creativity	Pleasure, Arousal	Cohen and Areni (1991), Mower and Minor (2001), Demirbilek and Sener (2003), Karlsson <i>et al.</i> (2003), Liu (2003), Yun <i>et al.</i> (2003)
Preference	The preference for product creativity	Centrality, Applicability	Christiaans (2002), Bloch <i>et al.</i> (2003)

major three factors of product creativity (Besemer and Treffinger 1981). The Creative Product Semantic Scale has been used to validate this model across several types of consumer products by measuring the three dimensions of product creativity with nine associated sub-scales (Besemer and O'Quinn 1986, 1987, 1999). Thus, the novelty, resolution and elaboration and synthesis dimensions are the attribute dimensions of product creativity.

Looking at the second part of the product creativity definition, the terms arousal and pleasure pertain to the emotional impact or affect of the product on the consumer. Thus, arousal and pleasure form the next two dimensions of product creativity. The recent study by Christiaans (2002) found that impact on the observer is a critical component in the evaluation of creativity. The researcher defines a creative design to be one that 'triggers attention and fantasy and acts on our emotions' (Christiaans 2002, p. 48). This notion of emotional impact is also supported by a study investigating dimensions of ad creativity that found valence of feelings to be a significant factor in the measurement of creativity (Ang and Low 2000). As mentioned before, the major dimensions of affect towards a product include arousal and pleasure (Gardner 1985, Cohen and Areni 1991, Liu 2003). Therefore, the fourth and fifth dimensions of product creativity are arousal and pleasure, which are the affect dimensions.

The last part of the product creativity definition addresses the judge's or consumer's preferences. Product creativity is related to preference in two ways: the consumer's interest in creativity (centrality) and the importance of creativity to the consumer (applicability). Christiaans' (2002) recent study on product creativity showed a significantly high correlation between creativity and product preference ($r=0.89$ at $p<0.01$), which indicates the need to include preference dimensions to better assess product creativity. A similar type of preference assessment is found in the assessment of the centrality of visual product aesthetics (Bloch *et al.* 2003). This study by Bloch *et al.* (2003) showed that the personal value of aesthetics is a measure of the centrality of aesthetics. Without measures of preference, the individual differences in the assessment of creativity may not be representative. For example, two consumers may judge the product attributes and general feelings towards the product to be similar, but have differences in the overall assessment of creativity because one consumer did not find the product to be important and interesting. Therefore, the consumers' preferences for the product play a role in determining product creativity. Thus, the last two dimensions of product creativity (specifically the preference dimensions) are centrality and applicability.

In sum, the construct of product creativity is broken down into a total of seven dimensions: novelty, resolution, elaboration and synthesis, arousal, pleasure, centrality and applicability. The seven dimensions group into three types: attribute dimensions, affect dimensions and preference dimensions. The dimensions' influence or role in product evaluation is better understood by first making a distinction between the perception and the expectation of the dimensions and then discussing the dimensions' relevancy to consumer attitude and finally illustrating the dimensions' role in an information processing model of product creativity evaluation.

3.3. Information processing of product creativity assessment

The process of assessing and responding to product creativity is best explained with a model of information processing. The elaborated model of the human information

processing by Proctor and Van Zandt (1994) provides a structure to develop the information processing model of product creativity assessment. The proposed model of how consumers evaluate product creativity is presented in figure 1. Overall, this model shows the process of how consumers comprehend information about a product and compare that information to a set of creativity criterion in order to determine the level of product creativity and how consumers respond to the product creativity evaluation.

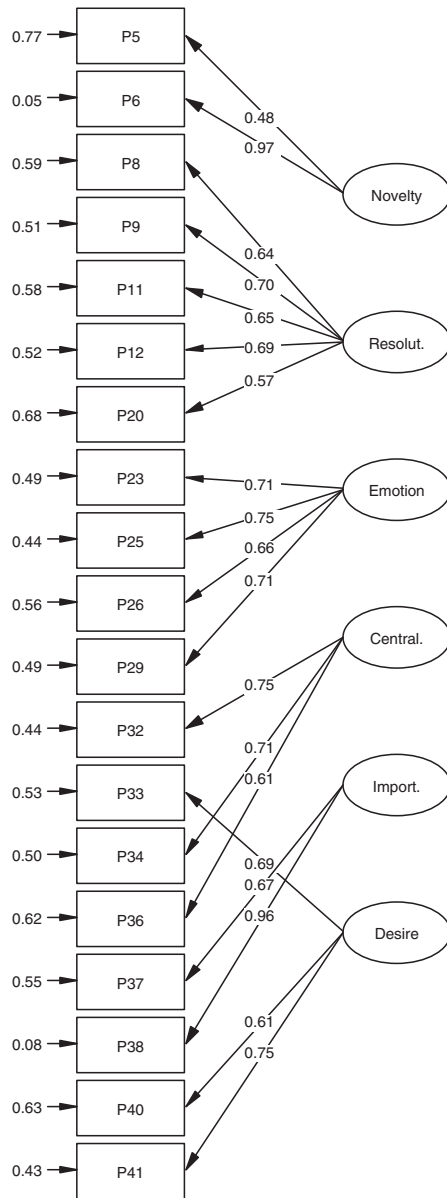


Figure 1. Standardized LISREL estimates of the product creativity measurement model ($\chi^2 = 174.69$, $df = 137$, $p = 0.016$, $RMSEA = 0.037$).

The process of assessing product creativity begins with the interaction between the product, consumer and context. The necessity for this interaction is based on the previously described system's theory that claims product creativity is dependent on the interaction between the judge, product and context (Csikszentmihalyi 1988, 1999). The information processing process is then broken down into three stages: sensation, perception and cognition and, finally, response. The first stage begins with sensation of the interaction between the product, consumer and context. The consumer senses the interaction with both external sensors (eyes, ears, nose, mouth and skin) and internal sensors that measure the state of the blood and other bodily conditions (Bailey 1996).

The second stage is the perception and cognition stage, which involves the understanding and comparison of product information that result from the sensation of information. Continuing with the systems approach, the sensations from the interaction between the context, product and consumer contribute to the understanding of the interaction and the involved components. In other words, the sensation of the interaction between the context, product and person leads the consumer to perceive the status of the context, the product and him or herself. Then the consumer's realization of system components contributes to the consumer's understanding of the system components. More specifically, realizing the status of the context leads to becoming aware of the context; realizing the product status leads to recognition of product attributes; and realizing the consumer status leads to awareness of emotional impact. These understandings of the three components are general assessments from the interaction, not specific to any type of evaluation.

The specific assessment of product creativity involves making a comparison of this general assessment from the interaction against a set of creativity criteria (the seven dimensions of product creativity). These criteria or dimensions as previously described are a universal set of guidelines stored in memory (indirectly influenced by the consumer's experience and culture). The consumer perceives the level of product creativity (in each dimension) by comparing the general understanding of the context, product attributes and the affect from the interaction with the specific creativity criterion.

The final stage of the information processing model is the response to the product creativity. The creativity of a product contributes directly to consumer attitudes, but is assumed to be only one of numerous factors that also lead to consumer attitudes, namely purchase intentions and consumer satisfaction. In sum, the information processing model illustrates how the consumer compares general product assessment with a specific set of creativity criteria to assess and respond to the product creativity.

An example of assessing the creativity of a glider-chair helps to illustrate this model. The consumer interacts with the chair and senses this interaction. The consumer understands the context or environment in which the chair is used, realizes the specific features of the chair and becomes aware of the affect from the chair. The consumer determines the level of perceived creativity by comparing this general understanding of the chair, context and feelings towards the chair with a list of criteria (novelty, resolution, elaboration and synthesis, arousal, pleasure, centrality, applicability). Finally, the person perceived the level of creativity and determines the overall value added to the product design. This added value then contributes to the consumer's decision to buy the product and also leads to the satisfaction with the product.

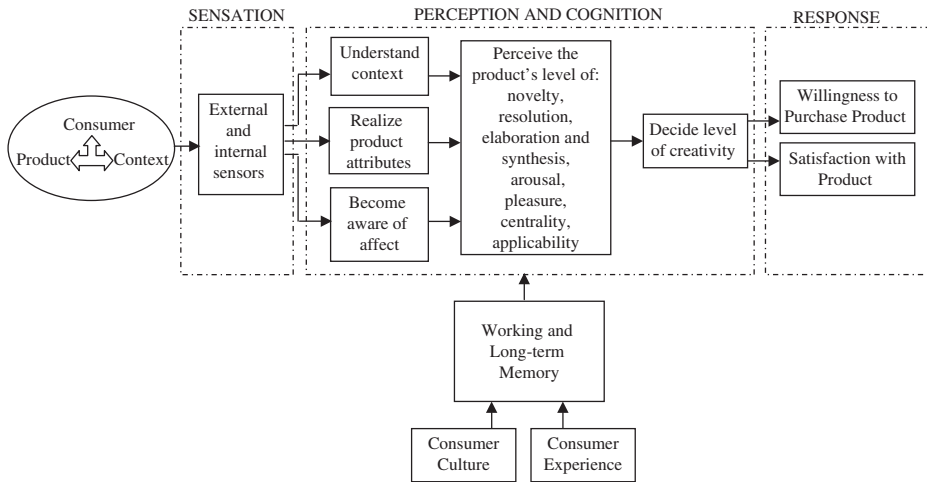


Figure 2. Information processing model of product creativity assessment.

3.4. Customer attitude

Each of the seven dimensions of product creativity just described is also important for the prediction of consumer attitudes, as shown in figure 2. Research shows that purchase intentions are influenced by evaluations of product attributes (similar to novelty, resolution and style) (Mower and Minor 2001, Mello 2002), consumer affect (similar to pleasure and arousal) (Cohen and Areni 1991), as well as consumer preference compatibility (similar to centrality and applicability) (Bloch *et al.* 2003). Research also shows that consumer satisfaction is related to evaluations of product attributes (Gise and Cote 2000, Yun *et al.* 2003), consumer affect (Cohen and Areni 1991, Ang and Low 2000) and consumer preference (Mower and Minor 2001, Han and Hong 2003). A meta-analysis of consumer satisfaction studies revealed that disconfirmation (measured from expectancies and perceptions) exhibits the highest correlation compared to other variables with the prediction of satisfaction (Szymanski and Henard 2001).

Therefore, the figure of the perception/expectation assessment of product creativity illustrates how the disconfirmation between the expectations and perceptions for each dimension of product creativity adds value to the product evaluation, which in turn influences consumer satisfaction and purchase intentions. For example, the consumer satisfaction with the product will be greater if the level of product creativity that a consumer perceives exceeds what he or she expected, versus if the perceived product creativity is below the level of creativity expected. The figure shows how product creativity assessment leads to customer satisfaction, but it is important to note that product creativity is not the only contributor to product satisfaction and purchase intentions. The figure only shows the relationship between these customer attitudes and product creativity assessment. Other factors such as price, usability, quality, etc., also contribute to the satisfaction and purchasability of the product. The primary concern of this study is product creativity, thus other factors and the relationship with customer attitudes are not addressed extensively. To further describe how the dimensions of product creativity (perceived and

expected) influence product evaluation and customer attitudes, the information processing model is utilized to illustrate the process of assessment and response to creativity.

4. Methodology

The objectives of this study could be achieved by two methods: protocol analysis and questionnaire analysis. Protocol analysis has the advantages of capturing all dimensions of the phenomenon investigated, but it is very time consuming for both the experimenter and the subject. This method is deemed inappropriate and not practical to use in this study. Thus, a questionnaire is the main instrument utilized in this study to measure the consumer of product creativity. In the first phase, the product creativity instrument structure and measurement items were established based on the previously discussed conceptual model and dimensions of product creativity. During the second phase of development, the instrument was tested and purified by analysing a sample of data. The data in phase two pertain to the respondents' general assessment of product creativity, not creativity in a specific product.

4.1. Participants

No participants are utilized in the first phase of instrument development. For the second phase (initial testing and purification), the data from 205 subjects were collected. Given the instrument size and the number of independent items, 200 subjects is the minimum amount recommended for the application of statistical techniques to test the instrument structure and reduce the instrument items. The subjects were recruited from a consumer science classroom, engineering classroom and psychological classroom. Of the 200 consumer science undergraduate students, 100 engineering undergraduate students and 20 psychological undergraduate students, 205 surveys were completed. Seventy-two per cent of the subjects were male. The average age of the subjects was 23 years old, of which 53% claimed to own a creative product. The two phases of the instrument development are described in more detail in the next section.

4.2. Phase I: generation of the product creativity instrument

4.2.1. Instrument structure. Based on the conceptual model and the seven dimensions of product creativity previously described, the instrument to be utilized in this study includes 90 items to measure the seven dimensions (divided into three components) and customer attitude (a fourth component). To fully explain, novelty (seven items), resolution (seven items) and elaboration and synthesis (seven items) dimensions form the attribute component; pleasure (five items) and arousal (five items) dimensions form the affect component and centrality (five items) and applicability (five items) dimensions form the preference component. In summary, the 41 items in the product creativity measurement instrument (listed in table 2) are based on the following sources:

- The novelty, resolution and elaboration and synthesis measurement items are based on the validated Creative Product Analysis Matrix model by Bessemer

Table 2. Dimensions and measurement items of product creativity.

Product creativity dimension	Measurement items
Novelty	Different–typical, unconventional–conventional, abnormal–average, unknown–familiar, infrequent–frequent, rare–standard, extraordinary–regular
Resolution	Efficient–inefficient, resourceful–wasteful, productive–unproductive, fitting–unsuitable, functional–impractical, convenient–inconvenient, sensible–unrealistic
Elaboration and synthesis	Integrated–disjointed, coherent–jumbled, detailed–vague, refined–undeveloped, deliberate–accidental, polished–rough, balanced–unbalanced
Pleasure	Pleasant–unpleasant, pleased–displeased, good–bad, delighted–horrified, appealed–revolted
Arousal	Fascinated–repulsed, excited–bored, stimulated–irritated, engaged–annoyed, exhilarated–depressed
Centrality	Favourable–unfavourable, desirable–undesirable, appealing–unappealing, interesting–uninteresting, attractive–unattractive
Applicability	Important–unimportant, relevant–irrelevant, necessary–unnecessary, significant–insignificant, ideal–unsuitable

and Treffinger (1981) and content derived from previous studies presented in the literature review.

- The pleasure, arousal, centrality and applicability measurement items deployed for this study are based on the content derived from studies presented in the literature review.

All responses to the survey are scored on a seven-point Likert scale ranging from 1–7. These instrument items contain bipolar adjective on a continuum scale with associated wording for each increment (i.e. 1: extremely dull, 2: dull, 3: slightly dull, 4: neither dull nor exciting, 5: slightly exciting, 6: exciting, 7: extremely exciting) to reduce the potential for inter-rater variability. Approximately half of the measurement items were reversed to reduce response bias. The scores from the reversed items were transformed back before statistical analysis was performed. If interested, please contact authors for sample of questionnaire.

4.2.2. Measurement items. The first three dimensions (novelty, resolution and elaboration and synthesis) measures the product characteristics associated with creativity (see table 2). The Creative Product Analysis Matrix (CPAM) is the main model selected for developing the items for the attributes of product creativity (Besemer and Treffinger 1981, O’Quin and Besemer 1999). The three dimensions of this model (novelty, resolution and elaboration and synthesis) are the three dimensions selected for measurement. The adjective pairs are based on associated wording from the oral statements from the individual interviews on creativity (Christiaans 2002) and from the definitions of the CPAM dimensions (Besemer and Treffinger 1981). The 21-item pairs for the first three dimensions are listed in table 2.

The fourth and fifth dimensions (arousal and pleasure) measure the emotional impact of the product creativity. Each adjective pair is based on two of the dimensions from the PAD (Pleasure, Arousal and Dominance) model of emotions,

which was previously developed and validated (Mehrabian and Russell 1974, Mehrabain 1995). The adjective pairs are also derived from associated wording in literature (Gardner 1985, Cohen and Areni 1991, Mower and Minor 2001, Demirbilek and Sener 2003, Karlsson *et al.* 2003, Liu 2003, Yun *et al.* 2003). The 10 item pairs for fourth and fifth dimensions are listed in table 2.

The centrality and applicability dimensions measure the preference for product creativity. The centrality and applicability dimensions are based on the interest and involvement dimensions of the Revised RPII (Revised Personal Involvement Inventory), which was developed and validated by McQuarrie and Munson (1991). The centrality of creativity assesses the level of interest in the product. Applicability measures how important the product is to the person. The adjective pairs for each item are based on associated wording in literature (McQuarrie and Munson 1991, Mower and Minor 2001, Christiaans 2002, Bloch *et al.* 2003). The 10 item pairs for centrality and applicability are listed in table 2.

4.3. Phase II: testing and purification of the product creativity instrument

4.3.1. Procedure. A paper-based survey including all of the items on the proposed instrument was given to each of the students in the three classrooms. The participants were asked to complete the questionnaire based on his or her previous experience with creative products. The participants were instructed to be careful, but not spend too much time to respond to each item. Data were stored anonymously in a database.

4.3.2. Statistical analysis. The instrument measuring product creativity incurred several stages of testing and purification. The first step was to initially verify the appropriateness and stability of the proposed instruments in a pilot study with a small sample of the data collected from the instrument. Once the instrument was deemed acceptable, then an analysis was conducted on the full set of data. Initially, the overall internal consistency was verified to insure the consistency of responses ($\alpha = 0.87$). Then an exploratory factor analysis was performed with the scores from the measurement items to determine the number of factors and appropriate measurement items. Factors with eigenvalues greater than 1.0 before the scree plot slope levels off and items with loadings greater than 0.50 were used as the general criteria for selection of items. The instrument was purified by removing items with low loadings (< 0.50) or cross-loadings on the factors (items with < 0.50 on more than one factor). Once the instrument was purified or reduced, a confirmatory factor analysis was then performed to verify the model's and latent variables' appropriateness (using a criterion of explained variance > 0.60 , goodness of fit index and normed fit index > 0.90 to be deemed as acceptable, as suggested by Cuttance and Ecob (1987)). All data analysis was performed using SPSS version 12.0 (2003) with the exception of the confirmatory factor analysis, which was performed using LISREL 8.5 (Jöreskog and Sörbom 2001).

4.4. Instrument validation

After the product creativity instrument was tested and purified, the instrument's predictive validity was examined. Additional questions regarding consumer attitude towards product creativity were incorporated to test the predictive validity of the

product creativity instrument. This attitude towards product creativity was assessed through the measurement of willingness to purchase and consumer satisfaction with the product creativity. The consumer attitudes were measured with item adjective pairs based on associated wording in literature (Cohen and Areni 1991, Ang and Low 2000, Gise and Cote 2000, Szymanski and Henard 2001, Bloch *et al.* 2003, Yun *et al.* 2003). Purchase intentions were measured with the following pairs: willing to pay for–not willing to pay for; want to purchase–do not want to purchase; and worth owning–not worth owning. Consumer satisfaction was measured with the following pairs: satisfied–dissatisfied; content–disappointed; and delighted–displeased. The next section presents the results of these analyses.

5. Results

5.1. *Exploratory factor analysis of the product creativity measurement model*

In order to determine the dimensions of product creativity, an exploratory factor analysis of the product creativity measurement items was completed. Initially, 11 factors had eigenvalues equal to or greater than 1.00 with the explained variance totaling to 63.0%. However, testing of seven or greater factors resulted in one or more communality estimates to be greater than one indicating an inappropriate number of factors (Tabachnick and Fidell 1996). The six factor structure was confirmed with the scree test (Cattell 1978), which showed a smooth decrease in the slope after six factors. Thus, six factors (which accounted for 48.3% of the explained variance before extraneous variables were eliminated) were selected as the appropriate number of product creativity dimensions.

Both orthogonal and oblique rotation methods produced equivalent factor loading patterns. Items with loadings (correlation between each item and each factor) lower than 0.50 were considered not significant and eliminated. Table 3 lists the items that have a loading of 0.50 or higher. The eigenvalues, percentage variance and Chronbach's alphas listed at the bottom of table 3 were calculated after removing the insignificant factor loadings. The total percentage variance explained by the three factors was 64.8%, which, although it is not considered to be high, is comparable to other studies involving factor analysis of creativity. A study by Lapierre and Giroux (2003) that tested a six-dimensional model of creativity work environment explained 66.9% of the total variance. Another study by Aguilar-Alonso (1996) explained 61.2% of the variance with an eight-dimensional model of creative behaviour.

As seen in table 3, the items loading on factor one pertain to the product uniqueness, thus is classified as Novelty. In factor two, the loading items address the product's ability to be functional and efficient, thus the factor is labelled Resolution. These two factor labels are consistent with the novelty and resolution dimensions from the Creative Product Semantic Scale (Besemer 1998). The third factor contains items that related to the emotional draw to the product, thus was labelled as Emotion. The fourth factor items are consistent with the proposed centrality dimension that addresses the attraction to the product, therefore labelled as Centrality. All of the items that loaded in the fifth and sixth factor (except for desirable-undesirable) were proposed to measure product applicability. These items of the fifth factor pertain more to the importance of the product, whereas the items

Table 3. Reduced factor loadings* for product creativity measurement items.

Product creativity item pairs	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
P5 Infrequent–frequent	0.67	−0.03	0.06	−0.05	0.06	−0.04
P6 Rare–standard	0.71	−0.01	0.01	−0.02	0.00	0.05
P8 Efficient–inefficient	−0.03	0.51	0.13	0.09	0.01	0.11
P9 Resourceful–wasteful	0.02	0.64	0.23	0.04	0.07	0.11
P11 Fitting–unsuitable	−0.06	0.61	0.19	0.06	0.12	0.09
P12 Functional–impractical	−0.08	0.69	0.12	0.13	0.14	0.03
P20 Polished–rough	0.10	0.52	0.03	0.16	0.01	0.24
P23 Pleased–displeased	0.01	0.24	0.58	0.08	0.11	0.11
P25 Delighted–horrified	0.01	0.04	0.62	0.31	0.18	0.14
P26 Appealed–revolted	−0.02	0.21	0.64	0.06	−0.14	0.14
P29 Stimulated–irritated	0.12	0.24	0.60	0.13	0.14	0.11
P32 Favourable–unfavourable	−0.03	0.16	0.15	0.73	0.13	0.15
P34 Appealing–unappealing	−0.09	0.12	0.19	0.64	−0.04	0.22
P36 Attractive–unattractive	0.01	0.13	0.10	0.57	0.23	0.06
P37 Important–unimportant	0.07	0.20	0.10	0.07	0.85	0.11
P38 Relevant–irrelevant	0.02	0.08	0.10	0.30	0.67	0.23
P33 Desirable–undesirable	0.10	0.14	0.11	0.20	0.04	0.64
P40 Crucial–insignificant	−0.07	0.18	0.14	0.01	0.16	0.58
P41 Ideal–unsuitable	−0.01	0.13	0.18	0.24	0.13	0.61
Eigenvalue	1.18	5.07	1.74	1.61	1.45	1.27
% Variance explained**	6.2	26.7	9.1	8.4	7.6	6.7
Cronbach's α	0.63	0.75	0.76	0.71	0.79	0.69

Note: Factor 1 = Novelty, Factor 2 = Resolution, Factor 3 = Emotion, Factor 4 = Attraction, Factor 5 = Importance, Factor 6 = Desire. Emboldened numbers indicate high loadings.

*The factor loadings are from a maximum likelihood, varimax rotated factor analysis.

**Total variance explained = 64.8%.

in the sixth factor relate more to the product desirability, thus factor five is Importance and factor six is Desire.

5.2. Confirmatory factor analysis of the product creativity measurement model

The six-factor model was further tested for stability with a maximum-likelihood confirmatory factor analysis using LISREL 8.5 (Jöreskog and Sörbom 2001). The model's goodness of fit statistics, based on the covariance matrix of the remaining items, were within an acceptable range (goodness of fit index = 0.92, adjusted goodness of fit index = 0.89). Other reduced models were tested by removing lower loading items; however, the model containing the items listed in table 3 proved to be the best model with the lowest $\chi^2 = 182.74$ (137 degrees of freedom, $p = 0.016$, not significant at the $\alpha = 0.01$ level). The model proved acceptable based on other statistical tests including: normed fit index = 0.93; non-normed fit index = 0.98; comparative fit index = 0.98; and root mean square residual = 0.044. The standardized LISREL estimates from the resulting measurement model of product creativity are indicated in figure 1.

5.3. Predictive validity of the product creativity instrument

The final analysis of the product creativity instrument involved testing the instrument's ability to predict consumer attitudes. This predictive validity was examined

Table 4. Prediction of purchase intentions from the averages of the product creativity dimensions* with forward stepwise regression method.

Independent variable	Partial R^2	Model R^2	F -value	$Pr > F$
Centrality	0.25	0.25	62.8	< 0.0001
Importance	0.05	0.30	15.6	< 0.0001
Desire	0.03	0.33	8.2	0.005

*Centrality, Importance and Desire have significant changes in r^2 ($p < 0.05$). Novelty, Resolution and Emotion did not have significant changes in r^2 .

Table 5. Prediction of consumer satisfaction from the averages of the product creativity dimensions* with forward stepwise regression method.

Independent variable	Partial R^2	Model R^2	F -value	$Pr > F$
Centrality	0.30	0.30	81.6	< 0.0001
Desire	0.09	0.39	27.6	< 0.0001
Importance	0.01	0.40	5.1	0.025

*Centrality, Importance and Desire have significant changes in r^2 ($p < 0.05$). Novelty, Resolution and Emotion did not have significant changes in r^2 .

with two forward stepwise regressions. Both regressions used the average variable scores for each of the six factors as the independent variables. The first regression had willingness to purchase as the dependent variable. As seen in table 4, the Centrality, Importance and Desire factors each have a significant change in r^2 ($p < 0.05$), while the Novelty, Resolution and Emotion factors did not cause a significant change r^2 . The second regression had consumer satisfaction with product creativity as the dependent variable. Table 5 also indicates that the Centrality, Importance and Desire factors each caused significant change in r^2 ($p < 0.05$), while the Novelty, Resolution and Emotion factors did not cause a significant change in r^2 . In summary, the stepwise regression models support the predictive validity of the product creativity instrument.

6. Discussion

The exploratory and confirmatory factor analyses reveal six main dimensions of product creativity: Novelty, Resolution, Emotion, Centrality, Importance and Desire. These six dimensions are similar to the proposed dimensions. As previously mentioned, newness or novelty is often associated with creativity and part of most models of creativity. This study confirms that novelty is one of the dimensions of product creativity as was proposed in the Creative Product Analysis Matrix (Besemer and Treffinger 1981). Novelty is defined as the uniqueness and newness of a product.

Alongside Novelty, this study confirms a second dimension in the Creative Product Analysis Matrix, entitled resolution. Resolution is the product's value, functionality or ability to resolve a problem or situation in an efficient manner. This resolution is often incorporated into many definitions and models of creativity

that claim something has to be both original and valuable to be creative (Mayer 1999). This study did not support the third proposed dimension (Elaboration and Synthesis) of the Creative Product Analysis Matrix. This dimension was also weakly supported and questioned in previous studies (Besemer and O'Quin 1999, O'Quin and Besemer 1999, Christiaans 2002).

The third dimension of product creativity, Emotion, contains measurement items from both the proposed pleasure and arousal dimensions. These proposed dimensions were originally grouped together because both measure the affect or emotional response of creativity. Thus, this study shows that experiencing a positive, stimulating affect is a dimension in the judgement of product creativity. Numerous studies support this involvement of emotion with the judgement of creativity (Ang and Low 2000, Christiaans 2002, Liu 2003).

The last three dimensions (Centrality, Importance and Desire) are related to the consumer's involvement with the product. Centrality or the product's ability to match the consumer's interests is similar to the product's aesthetics. Importance addresses how important the product is to the consumer or how relevant the product is to the consumer application or need. Desire is defined as the level of criticality, suitability and desirability of the product. These three dimensions entail the consumer's individual preference for the product. As shown in previous studies, product preference and involvement influences the judgement of product characteristics, such as the creativity of products (Christiaans 2002, Bloch *et al.* 2003). These dimensions address the individual differences in the assessment of creativity, which help to explain for the variability in evaluating the creativity of consumer products.

Going back to the glider-chair example, a consumer would assess how creative the chair is by evaluating the level of novelty, resolution, emotional response, centrality, importance and desire that the user perceives. Based on these dimensions, the consumer then determines the overall level of creativity. Hypothetically speaking, a consumer may perceive a traditional rocking chair to have less novelty and feel less emotional response than with the rocker-glider, but perceive equal levels of resolution, centrality, importance and desire. Thus, the consumer would assess the glider-chair as more creative than the traditional rocker.

This study provides both theoretical and practical contributions. This study provides a validated framework for the investigation and further understanding of product creativity. This study reveals that product creativity consists of six dimensions: novelty, resolution, emotion, centrality, importance and desire. While other studies of creativity that utilized factor analysis did not specifically address product creativity, the current study corresponds to these studies in that there are similar levels of explained variance (60% to 65%) and similar numbers of creativity dimensions or factors (six to eight) (Aguilar-Alonso 1996, Lapierre and Giroux 2003). As mentioned before, product creativity may be seen as an outcome measure of the creative process, person or environment. Changes or enhancement of these creative processes, persons or environments can only truly be measured through the final product and its creativity. Thus, measuring the dimensions of the final creative product can lead to better understanding of the roles and results of the creative process, person or environment.

Also, the product development and marketing process may be enhanced through the use of the product creativity dimensions. By matching the design processes and marketing strategies with the dimensions of product creativity, companies may yield products and advertisements that better match consumer requirements.

The dimensions of product creativity provide a structure for consumer product designers and marketers to develop creative products.

This study reveals that product creativity plays a role in consumer behaviour. While no previous studies have shown a clear connection between product creativity and consumer satisfaction or willingness to purchase, one cannot assume that such a relationship does not exist. With the framework of product creativity dimensions, more solid investigation of the role of product creativity in consumer behaviour can be undertaken. This study supports that at least three product creativity dimensions (Centrality, Importance and Desire) explain the variance of consumer satisfaction with creative products (40%) and willingness to purchase creative products (33%). These results indicate that the creativity does impact consumer satisfaction and product purchasability.

7. Conclusion

This study validates six dimensions of product creativity: Novelty, Resolution, Emotion, Centrality, Importance and Desire. These six dimensions provide a theoretical and practical framework for further investigation of the role of creativity in product development and consumer behaviour. These dimensions of product creativity can be further validated by testing the product creativity instrument's ability to measure product creativity and predict consumer attitudes towards specific consumer products. The product creativity instruments should be validated across several consumer product types and levels of creativity. With the validated instrument, researchers and companies can better develop and market creative products.

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