Knots as an Incongruent Product Feature: A Demonstration of the Potential for Character-marked Hardwood Furniture

KNOTS AS AN INCONGRUENT PRODUCT FEATURE: A DEMONSTRATION OF THE POTENTIAL FOR CHARACTER-MARKED HARDWOOD FURNITURE

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ABSTRACT

Increased use of character-marks, or naturally occurring features of wood such as knots, in wood household furniture has received attention recently as a means for U.S. furniture manufacturers to make more efficient use of forest resources. However, little information exists concerning furniture retailers' perceptions of character-marked wood. Propositions that predicted retailer response to character-marked furniture based on categorization theory were developed and tested using oak furniture samples. Conjoint analysis indicated that the preference structure for character-marks was monotonic and negative in relation to increasing character-mark size, based on product evaluations involving buying consideration. The presence of character-marks was found to be somewhat important to product evaluations. The results suggest that although retailers evaluated products congruent with (or similar to) existing market conditions most favorably, opportunities exist for use of small or subtle character-marks in wood household furniture.

INTRODUCTION

The role of marketing in the promotion of environmentally conscious product design has received considerable attention (Lozada & Mintu-Wimsatt, 1995; Mackoy *et al.,* 1995). It is argued that marketing principles are well suited to encourage responsible and efficient use of natural resources, whether aimed at industrial, retail, or consumer segments. Wood-based industries are particularly sensitive to issues such as efficient resource utilization due to their reliance on a raw material base for which there are many competing uses (e.g., forest recreation and wildlife habitat). The use of character-marks[1] in wood household furniture products has received attention as a potential means of extending the forest resource and lowering raw material costs for U.S. manufacturers (Buehlmann et al., 1998; Araman, 1979). This appears to be a timely issue, as a recent study concluded that 50 percent of large residential furniture manufacturers in the United States and Canada were either *extremely* or *very* worried about wood supply issues. In addition, 30% indicated that they were more concerned about wood supply issues in 1998 than in 1997 (Adams, 1998). Furniture manufacturers can face pressure from both the supply and demand sides of the business to make more efficient use of wood resources. However, most hardwood furniture produced in the U.S. is made from essentially character-free wood parts, limiting the yield of usable wood from hardwood logs and lumber[2].

Although it has been argued that responsibility for promoting acceptance of character-marked woods lies in part with furniture manufacturers (Wilhelm, 1994), it is unclear whether push- or pull-type promotional strategies would be more effective in generating demand for character marked products. This study investigated perceptions of character-marked hardwood furniture among a sample of retail furniture buyers and managers located in two southeastern U.S. states with a substantial furniture industry. Such information is useful for determining the potential for push-type promotion of character-marked furniture. In the U.S. household furniture industry, where manufacturers direct most of their selling efforts and promotional messages toward retailers, the retail perspective of character-marked products becomes an important consideration in the distribution chain for character-marked products, although retailers may not always reflect the exact preferences and attitudes of consumers.

Conjoint analysis was used to determine the importance of character-marks to retailers' perceptions of wood household furniture products in relation to other important furniture attributes. The objective was to determine how knots, a specific and common type of character-mark, were perceived by retailers within hypothetical product profiles categorized as oak household furniture of country/casual styling. If character-marked products are perceived favorably, furniture

[1] Character-marks refer to naturally occurring features of wood, such as knots, color streaks, small holes, etc, that are considered defects under current hardwood lumber grading standards.

[2] In the current U.S. marketplace, "knotty" pine furniture is common but character-marked hardwood furniture, made from such species as oak and maple, is not.

manufacturers when developing new products, helping to extend the hardwood forest resource, can use such information.

PREVIOUS WORK AND PROPOSITIONS

Bloch (1995) claims that response to product design involves both categorization issues and product-related beliefs. A review of the literature is presented below that discusses these issues and leads to development of two propositions.

Product Categorization

It has been suggested that categorization, or perceiving of two or more distinguishable objects equivalently, is one of the most basic human functions (Mervis &. Rosch, 1981). Categorization theory suggests that individuals attempt to form beliefs about new products by placing them in stored mental representations of previous experience, or schemas (Mandler, 1982). Once a product is categorized, it is perceived to be similar to other products in the category.

Individuals develop product categories by learning what attributes are important to products in a category, what prices are typical, and the extent to which the category contains homogenous or differentiated products (Hutchinson & Alba, 1991). New products are placed into categories if they are judged to have a high degree of similarity with existing prototypes or characteristics of the category (Medin & Smith, 1984; Cohen, 1981). Categorization is important to marketing because unusual new products that are not easily categorized can lead to frustration on the part of consumers and retailers (Bloch, 1995; Cox & Locander, 1987). Mandler (1982) proposes a framework that predicts the relationship between levels of congruity (or similarity) with an activated schema (i.e., the product category that comes to mind when a new product is encountered) and the resulting product evaluation. When congruity exists between a new product and an existing category, a positive evaluation will generally result, but with little emotive intensity. Mandler (1982) refers to such instances as "cold" positive judgments. In the case of slight incongruity, a positive evaluation will generally result because the individual can assimilate the mild incongruence, fitting the product into a category. Such assimilation activity generates more emotive activity than the congruence case. When severe incongruence is realized, the individual will generally try to accommodate the product into an existing category, often with little success. This lack of success will lead to a negative evaluation. Meyers-Levy and Tybout (1989) found that moderate levels of congruity with existing product categories led to more favorable evaluations of new soft drink and fruit juice products than did high levels of congruity or extreme incongruity. Similar findings were obtained by Stay man *et al.* (1992), who found that moderate incongruity between product trial experiences and written pre-trial descriptions of soft drinks and fruit juices led to more favorable evaluations than conditions of congruity or extreme incongruity. Meyers-Levy and Tybout (1989) caution that results might be different for different types of products, such as those that evoke more intense emotional effects and require high involvement purchasing decisions, and among persons with different levels of experience such as novices and experts.

The key attribute that was investigated in this study was *Knot Size,* which described knot size in oak household furniture parts. The *Knot Size* attribute was varied at three different levels: *no knots, small knots* (diameter $\leq$ ½"), and *large knots* (diameter $\leq$ 1"). Based on the preceding review, it was expected that the most favorable *Knot Size* level would be *small knots,* representing the level with moderate incongruity with the oak household furniture category. As previously discussed, most oak furniture on the U.S. market is knot-free. The remaining product attributes investigated in this study *(Finish, Style,* and *Aspect* (i.e., vertical vs. horizontal surfaces)) were varied at levels consistent with current market conditions, thus no congruity issues were expected with these attribute levels. Previous work concerning product categorization suggested the following propositions concerning character-marks in hardwood furniture:

Proposition l. The attribute levels will be evaluated as follows:

la) The level of moderate incongruity in the *Knot Size* attribute *(small knots)* will be evaluated more favorably than the congruent level *(no knots)* and the extreme incongruent level *(large knots).*

1b) There will be no significant differences in the evaluations of the levels of the *Finish, Style,* and *Aspect* attributes, since all will be congruent with existing market conditions.

Product-Related Beliefs

Bloch (1995) and Durgee (1988) point out two distinct streams of thought regarding the cognitive processing by which product beliefs are derived - *holistic* processing and *atomistic* processing. The derivation of product beliefs has implications in terms of whether character-marks are seen as a distinct product attribute or as an interacting component of a holistic piece of furniture. When holistic processing is involved, products are evaluated as a whole and not merely as a collection of separate attributes (Murray, 1995; Holbrook and Moore, 1981). Atomistic processing involves a consideration of individual product attributes, whereby beliefs about a product are derived by combining those subjective values that are assigned to the individual attributes (Bloch, 1995; Sujan, 1985). Durgee (1988) claims it is useful to break products down into their basic elements or attributes, which can then be measured to determine the ways a product is perceived. Hutchinson and Alba (1991) found that individuals tended to use a subset of two or three attributes 1Tom a larger set when evaluating stereo speakers. The fact that salience was weighted differently among the investigated attributes suggested that respondents were using attribute-specific rules (i.e., atomistic processing) *for* evaluation as opposed to holistic-type processing. Sujan (1985) found that expert consumers relied more heavily than novice consumers on an atomistic approach to product evaluation when confronted with incongruent products.

Inferences about attribute-based product evaluations can be drawn from the psychology literature as well. Wallsten and Budescu (1981), for example, found that experienced clinical psychologists utilized a more complex evaluation method than did psychology graduate students in their evaluation of a 14 factor personality profile. The graduate students tended to use only the 2 or 3 most salient factors in an additive fashion, while the clinical psychologists often utilized 4 to 7 factors. These authors concluded that complex tasks could be approached with additive models that considered only the most salient of several possible factors, although experience seemed to playa role in the complexity of the evaluation task.

It was expected that the incongruence associated with the *Knot Size* attribute would give it salience among the other product attributes. Such salience would make *Knot Size* particularly important to product evaluation if only a subset *of* the attributes were considered, as would be expected based on atomistic evaluation. The importance of character as a product attribute is an indication of the promotional efforts needed to encourage acceptance. These ideas resulted in a second proposition:

Proposition 2. The *Knot Size* attribute will be the most important to product evaluation due to its salience among the other furniture product attributes and the atomistic nature of product evaluation.

METHODS

Sample Description

The population of interest for this study was furniture retail buyers and managers in southwest Virginia and central North Carolina.As a fashion product, furniture is regionally marketed in the U.S., often with substantial differences in the popularity of styles and finishes among regions. The furniture market in the study region can generally be characterized as somewhat traditional, with medium finishes and casual styles being most common. Median personal income (per capita) in 1998 for 48 counties in the study region was $US 21,106, which was 78 percent of the national average (U.S. Department of Commerce 2000).

The sample frame was developed primarily from the *Furniture Today* (1997) list *of* the 100 largest furniture retailers (based on sales) in the United States. The first criterion for inclusion was that companies must have headquarters in North Carolina *or* Virginia. This resulted in a list of 11 companies, where the corporate furniture buyer was the interview target. Also, branch locations *of Furniture Today* listed companies located in the study region were included, where store managers were targeted *for* interviews. Finally, prominent independent furniture stores in southwest Virginia were included in the sample frame.

In total, a sample consisting *of* 19 respondents from 17 locations participated in the study. The positions of the persons interviewed are provided in Table 1. Many interviewees had direct responsibilities for buying new products for their companies (e.g., six of the respondents were the corporate buyers for *Furniture Today* listed companies). Some *of* the managers of specific locations *for* larger companies did not have direct responsibility for purchasing. However, these

persons indicated that they provided feedback to corporate buyers, based on what was selling in their respective stores, The sample was split somewhat evenly in terms of retail price-point, with slightly over half of the respondents representing relatively high price-points.

The limited geographic scope and relatively small sample size was a function of the data collection strategy, which involved on-site presentation of 20 furniture samples to respondents, Use of real wood furniture samples was believed to be more contented valid than pictorial or verbal representations would have been (Malhotra, 1996; Bloch, 1995). It has been suggested that actual product samples are particularly appropriate for conjoint studies associated with product styling (Green and Srinivasan, 1990).

Application of Conjoint Analysis

Medin and Smith (1984) propose that linear decision-making models like conjoint analysis can serve as useful tools for studying categorization issues. Conjoint analysis has been used extensively in product design evaluation research (Bloch, 1995), and there are examples of its use in studying wood products (e.g., Reddy & Bush, 1998). Ordinary least squares (OLS) regression has become a common estimation procedure in conjoint analysis (Green & Srinivasan, 1990), and was used in this study. Table 2 shows the attributes and corresponding levels of the attributes investigated. These attributes and levels were developed with guidance from representatives of academia and the furniture industry. Ozanne and Smith (1996) found some of these attributes (i.e., *Finish* and *Style)* to be important to furniture products. The *Aspect* attribute was included due to an anticipated interaction with *Knot Size,* but little evidence of interactions was found.

Since 3 x 3 x 2 x 2=36 product combinations were possible with a full factorial design of all attribute levels, an orthogonally arrayed fractional factorial design was employed.

Table 1. Positions of respondents within their respective companies.

Position	Number of Respondents
Buyers/Merchandisers	6
Store Managers	5
Store Owners	4
Interior Designers (with buying responsibilities)	2
Assistant Store Managers	2

Table 2. Attributes and associated levels used to develop the product profiles for the conjoint analysis.

ATTRIBUTES	LEVELS
Knot Size	a. no knots
	b. small knots (≤ ½" in diameter)
	c. large knots (< 1" in diameter)
Finish	a. clear
	b. medium cherry
	c. distressed [1]
Style	a. Shaker
	b. French Provincial
Aspect	a. horizontal
	b. vertical

[1] A "distressed" finish referred to application of a subtle paint spattering, which is a common finish for furniture with a casual or relaxed feel

A design that utilized 16 product profiles[3] was utilized, which resulted in 9 degrees of freedom for the main-effects model (dummy variables with effects coding was used to represent the attribute levels). Respondents evaluated a total of 20 product profiles, including four holdout profiles used to assess the reliability of the conjoint model. Figure 1 and Figure 2 show examples of the product profile representations.

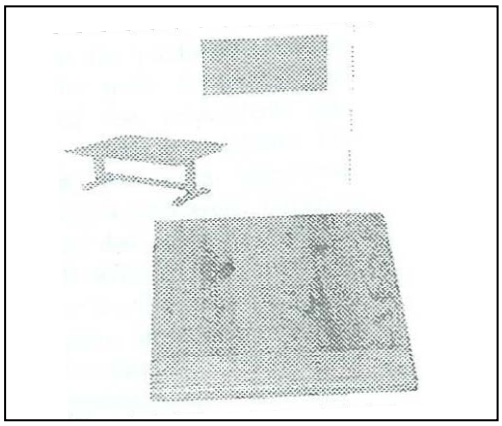

Figure 1. Product profile with large knots, medium cherry finish, Shaker style, and horizontal aspect.

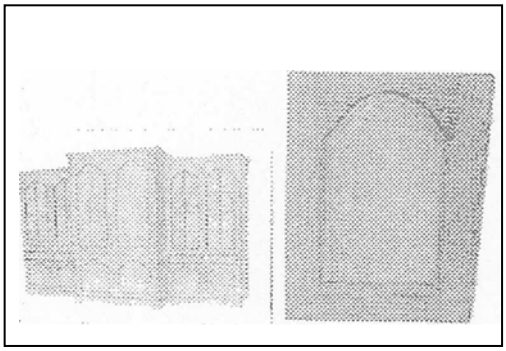

Figure 2. Product profile with no knots, clear finish, French Provincial style, and vertical aspect.

Before data collection began, respondents were presented with two pictures, rendered by a furniture designer, of an entire furniture group in a home interior setting. Each picture illustrated one of the two *Style* levels contained in the conjoint design. These pictures were intended to give respondents an idea of the overall product concept and to put the evaluation tasks in context.

[3] Product profiles involved a solid oak furniture part (either a door from an entertainment center or a comer of a tabletop) and a designer's rendition of the entire piece of furniture represented by the furniture part.

These pictures also served to activate the country/casual-styled oak furniture schema in the minds of respondents.

Data were gathered via questionnaire booklets administered on-site at store or corporate locations. The furniture part and picture representing each profile were shown to the respondent simultaneously, and removed from sight before evaluation of the next product profile began. Respondents evaluated each product profile in terms of buying consideration, which was operationalized with the following phrase: *I would consider buying this furniture product for my casual/country-style market.* The response was measured with a 7-point scale anchored by:

1= *strongly disagree* and

7 = *strongly agree.* A separate OLS model was generated for each respondent.

RESULTS

Conjoint Scores for the Attribute Levels

Once the individual conjoint scores were derived, it was possible to aggregate the individual scores by averaging across respondents for each attribute level. A cluster analysis using Ward's method on the conjoint scores indicated no well-defined clusters based on retail price-point, inclusion in the *Furniture Today* (1997) list, or branch versus headquarters location[4]. Thus the data were analyzed for the aggregated sample. Tests for normality were conducted on the utility score distributions (n= 19) for each attribute level, using Stephen's modification to the KolmogorovSmirnov one-sample test. These tests indicated that all of the data followed a normal distribution (α = 0.05), thus parametric one-way ANOV A tests were used to determine if differences existed between the levels of each attribute.

Table 3 indicates that a somewhat linear utility structure existed for the levels of the *Knot Size* attribute in terms of buying is, utility declined as the level went from *no knots* to *small knots* to *large knots.* This indicates that the *no knot* level contributed most favorably to the buying consideration evaluation. All three levels were significantly different from each other (a = 0.05) based on Fisher's LSD post hoc test. The *Finish* level of *medium cherry* was rated significantly higher than both the *clear* and *distressed* levels.

[4] Interestingly, when multiple locations of an individual company existed in the sample (e.g., corporate buyer and store manager), they tended to cluster together, suggesting consistency within companies.

No evidence of differences emerged between the levels of the *Style* and *Aspect* attributes. The average product moment correlation between the predicted values and actual values for the four-holdout product profiles for each respondent was moderately high (r = 0.66, using Fisher's z-transformation), suggesting acceptable reliability.

Figure 3 provides graphical representations of the individual conjoint score structures for *Knot Size.* This figure shows that the predicted structure *(small knots* being the most favorable) was followed by some of the respondents (26 percent). However, many respondents (37 percent) demonstrated decreasing monotonic preference from *no knots* to *large knots,* which is reflected in the aggregate data analysis. For each respondent, the spread between the most and least preferred *Knot Size* level is generally a good reflection of the relative importance of this attribute to the product evaluations. For many of the respondents demonstrating decreasing monotonic preference, the *Knot Size* attribute was quite important. Conversely, for most of the respondents demonstrating the "inverted U" structure, *Knot Size* was less important.

Relative Importance of the Attributes

Analysis of the data indicated that the *Knot Size* and *Finish* attributes were the most important to the evaluations of the product profiles based on the conjoint analysis (Figure 4). These attributes each had a relative importance to the product evaluations of approximately 35 %5, and were 17 % points higher in importance than the *Aspect* attribute. The *Style* attribute was the least important in the conjoint analysis, only about one-third as important as *Knot Size* and *Finish.*

Also, the results depicted in Figure 4 indicate that product attribute importance differed when respondents were asked directly to provide importance weights to the study attributes (by distributing 100 points among the attributes). While the results of the conjoint analysis and self-reported importance weights were similar for *Finish,* the magnitude of differences between the values for *Knot* Size was moderate, but quite large for *Style.* This could be a result of the specific levels of the *Knot Size* and *Style* attributes investigated. In the conjoint study, both levels of the *Style* attribute could be categorized as country/casual-type styles. Since respondents viewed these two levels as being similar, this drove down the importance of *Style* in the conjoint analysis, although style is generally thought to be an important furniture attribute. Similarly, the fact that most furniture is manufactured character-free might have reduced the self-reported importance and is an illustration of the importance of the presence of character to the product evaluations.

[5] An alternative method for calculating relative importance is to use the aggregated mean conjoint scores for the attribute levels that appear in Table 4. Using this method, the relative importance of *Knot Size* increases to 55 percent., but is partially an artifact of aggregation.

DISCUSSION

Proposition 1

Proposition la, which stated that the moderately incongruent *Knot Size* level of *small knots* would be evaluated most favorably, was not supported by the aggregate data. Although the incongruent level of *large knots* was evaluated least favorably in terms of buying consideration, as expected, the aggregate evaluation structure was monotonic rather than the "inverted-U shape" that was predicted. Clear wood was evaluated most favorably in the market studied. Respondents had considerable experience with wood household furniture, and this experience with the product class could have been a confounding factor. Also, the results might have been different had respondents evaluated the product profiles based on personal preference (i.e. as consumers) rather than on the basis of buying consideration for their market (i.e. as retailers), which involves a substantial degree of risk.

Proposition 1 b stated that there would be no differences between the levels of the remaining attributes since these levels were congruent with existing market conditions. This was partially supported by the data. The *medium cherry* level of the *Finish* attribute was rated highest in terms of buying consideration. The popularity of furniture finishes can fluctuate widely in the marketplace. It was indicated during the site visits that *medium cherry* was the most consistent (i.e. congruent) with existing market conditions, suggesting again that the relationship between attribute congruence and buying consideration was positive. There were no differences in buying consideration evaluations between the two levels of the *Style* attribute, or between the two levels of the *Aspect* attribute, as predicted.

Table 3. Mean conjoint scores, ANOVA results, and Fisher's LSD post hoc comparisons for each attribute level. Mean regression statistics are also shown.

Attribute	Level	Mean Score	Standard Error
Knot Size[a]	no knots	0.35	0.12
	small knots	0.02	0.08
	large knots	-0.37	0.13
Finish[b]	clear	-0.13	0.10
	medium cherry	0.26	0.10
	distressed	-0.13	0.15
Style[c]	Shaker	-0.01	0.05
	French Provincial	0.01	0.05
Aspect[c]	vertical	0.08	0.08
	horizontal	-0.08	0.08
Regression Statistics	mean intercept	4.44	
	mean R^2	0.54	
	mean adj. R^2	0.29	

[a] ANOVA p-value < 0.01; no knots significantly different than small knots and large knots (a. = 0.05); small knots significantly different than large knots (a.=0.05) based on Fisher's LSD tests.
[b] ANOVA p-value = 0.03; medium cherry significantly different than clear and distressed (a. = 0.05) based on Fisher's LSD tests.
[c] no significant difference between attribute levels

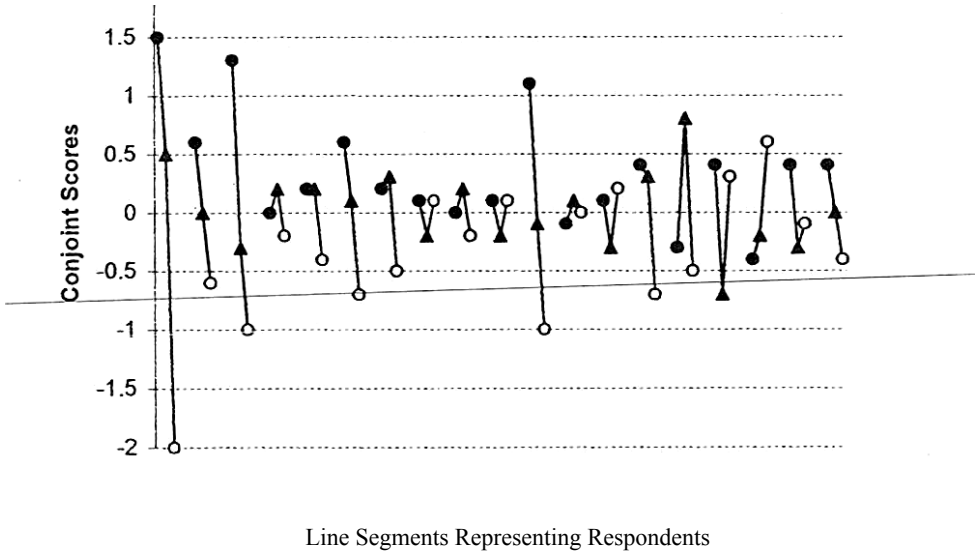

Figure 3. Individual conjoint score structures (n = 19) for the *no knots* (solid circles), *small knots* (triangles), and *large knots* (open circles) levels of the *Knot Size* attribute. Positive values contribute favorably to buying consideration, while negative scores detract from buying consideration.

Proposition 2

Proposition 2, which stated that the *Knot Size* attribute would be the most important to the evaluation tasks due to its salience compared to the other variables, was partially supported. *Knot Size* accounted for approximately 35% of the importance to the buying consideration evaluation, as did *Finish.* Thus, *Knot Size* and *Finish* emerged as equally important to the evaluations. The fact that two variables out of four emerged as substantially more influential to the evaluation tasks suggests that a subset of the attributes served as the basis for evaluation, but this finding should be viewed with caution since the relative importance of *Style* was likely driven down in importance based on the attribute levels in vestigated.

Limitations and Future Research

The geographic scope in this study was limited. Although this was deemed an acceptable tradeoff in order to improve the content validity of product evaluation, these results are only suggestive of overall retailer reactions to character-marked furniture. Further investigations are warranted. One opportunity for increasing sample size without losing the inherent validity of using real wood samples for evaluation would be to set up booths at trade shows where visitors represent identifiable populations of interest. Another opportunity for future research is to assess consumer acceptance of character-marks. Perhaps there are opportunities, not fully realized by manufacturers, for pull-type promotion of character-marked furniture, where messages aimed directly at consumers could stress the unique and individual nature of character-marked products.

The R2 values obtained in this study were generally low to moderately large. A possible explanation for low R2 values is the nature of wood itself. Even though the product attributes were controlled, variance in color and knot appearance existed between the products and affected respondent evaluation in some cases (as indicated by some respondents during the interviews). Such variance is practically impossible to eliminate, especially in production operations. This illustrates one of the problems associated with production and marketing of character-marked furniture. Even though *quantitative* standards can exist (e.g. knot size < *Yz* inch), it is more difficult to control for the *appearance* of knots in a consistent manner.

IMPLICATIONS

The results of this study suggest that opportunities exist for increased use of small character-marks by manufacturers willing to break from existing U.S. marketplace norms. Although knot-tree furniture was evaluated most favorably by a sample of retail buyers and managers in terms of buying consideration, small knots were evaluated more favorably than large

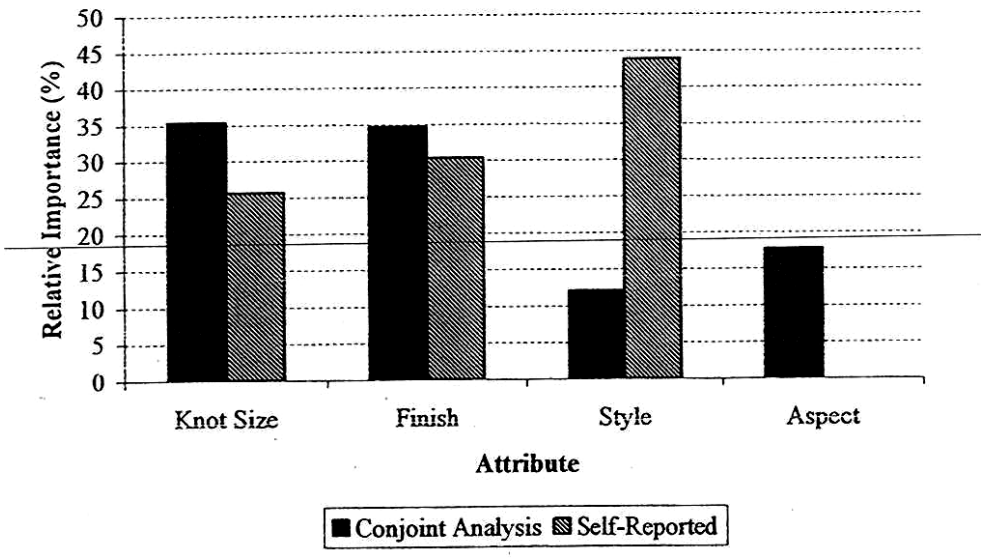

Figure 4. The relative importance of the study attributes to buying consideration, based on the conjoint analysis and self-reported values (no self-reported values were generated for *Aspect* since both vertical and horizontal surfaces are involved in most furniture purchases).

knots. Use of character-marks, at least for now, should be subtle to be somewhat congruent with existing market conditions of no or few knots.

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CONTENTS Page

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