CONSUMER PERCEPTIONS AND PREFERENCES ON SOLID WOOD, WOOD-BASED PANELS, AND COMPOSITES: A REPERTORY GRID STUDY

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Abstract. Knowledge about consumer perception and preferences on solid wood, wood-based panels, and wood-based composites is important for product development and marketing. The aim of this study was to identify attributes and associations that people use to describe different types of wood materials and to explore how they relate to preferences. The study involved nine samples that were evaluated with the Kelly's repertory grid technique and content analysis. Based on respondents' answers, 19 core categories reflecting sample attributes were extracted. General preferences for each sample were also recorded. Principal component analysis generated two factors describing 1) naturalness, wood-likeness, softness, unprocessed origin, living, pleasant, and high value; and 2) solid and homogeneous impression. A third, preliminary factor included categories describing irregular pattern, sleekness, and smoothness. The wood samples were most liked, whereas composites and panels were not appreciated. Preferred core categories were naturalness, wood-likeness, smoothness, living impression, and value. The least liked core categories were processed, hard, and high weight. The implications of the results for product development and marketing are discussed.

Keywords: Attribute elicitation, Kelly's repertory grid, consumer research, content analysis.

BACKGROUND: WOOD AND WOOD-BASED COMPOSITES

Wood can be processed to varying degrees before it is marketed in its final form. The human perceptions of wood products and their origin vary; solid wood conveys specific impressions and associations, whereas processed wood and wood composites may generate perceptions and associations that do not necessarily relate to their natural origin. Although some wood-based materials have unique properties, which make them

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appropriate for specific applications, they are also substitutes in visible uses. Outdoor decks and window frames can for instance be made of both solid wood and composites; panels can substitute for solid wood in interior uses; and both wood plastic composites and panels can be used in walls and flooring (Tsoumis 1991; Clemons 2002; Juslin and Hansen 2002). Wood-plastic composites are claimed to possess natural wood-like properties combined with lower maintenance needs, whereas producers of solid wood products often use arguments like "There is no substitute for the look and feel of real wood, a truly natural product." Some panel products are promoted as visually appealing and flexible material for furniture and interior uses. Even structural panels products such as oriented strandboard (OSB) are sometimes used in exposed applications, eg, in shop interior uses.

Little is known about how consumers discriminate between different processed wood-based products and solid wood, and how perceived distinguishing attributes relate to preferences. Both industry reports and scientific studies have emphasized the importance of a deeper knowledge of consumer perceptions and preferences for gaining a competitive advantage in wood product markets (CEI-Bois 2004; Brandt and Shook 2005).

The typical characteristics consumers assign to the wooden material have been studied by a number of researchers (Broman 2000; Pakarinen and Asikainen 2001; Bowe and Bumgardner 2004; Scholz and Decker 2007). Attempts have also been made to map how properties of wood are related to preferences (Marchal and Mothe 1994; Broman 2000; Nyrud et al 2008). The effect of background and profession on preferences have also been investigated (Marchal and Mothe 1994; Roos and Nyrud 2008). However, the study of how wood as a material is perceived and characterized in relation to alternative wood-based materials such as panels and wood-based composites remains to be conducted.

In biocomposites, at least one of the phases is derived from biological origin (Fowler et al 2006). We use the name "wood-based composites" when the matrix is reinforced with wood or processed wood fibers. Cellulose fibers can be combined with biological or synthetic polymers (Mohanty et al 2000; Fowler et al 2006). Biocomposites, in particular those with exclusively biodegradable phases, can boast of environmental advantages concurrent with performance improvements (Mohanty et al 2002). The most common biocomposites are wood–plastic composites (WPC), which are desirable mainly for their plasticity, resistance against biological degradation, and low maintenance requirements (Fowler et al 2006; Wechsler and Hiziroglu 2006). The WPC industry, which is growing, especially in North America, supplies materials used in such applications as automotive parts, decking, outdoor products, roof tiles, and windows (Clemons 2002).

The development of new materials for "construction, insulation, furniture, packaging, specialty papers, vehicles, textiles, and beyond" is explicitly targeted in the European Forest Technology Platform Strategic Research Agenda and in national forest research agendas (eg, the Swedish national research agenda for the forest sector). Hence, forest-based industries are preparing strategies for innovation-based development of new wood-based materials with new applications. However, an important issue for the success of wood-based composites is how they are perceived by customers and their comparison with solid wood (Pritchard 2004; Jacob 2006).

Knowledge about consumers' sensory and emotional associations and reactions toward solid wood and processed wood-based materials is of particular interest for the design of appropriate marketing and development strategies. For both the wood and composite industries, the key issue is to find the sensory attributes that distinguish the material from alternatives and that are correlated with peoples' preferences. The preferred attributes should be enhanced in product development and emphasized in market communication and promotion efforts. Correspondingly, "unpopular" attributes should be reduced, or

compensated for, to overcome attitudinal barriers among customers (Solomon 2006). Better knowledge about perceptions and attitudes toward materials can also be used for leveraging secondary brand associations in a process of strengthening a brand/product type (Håkansson 2000; Keller 2008). These considerations become central both for the solid wood industry, which is repeatedly challenged by new products and materials, and for the wood-based composite industry, which is still to some degree "exploring its proper applications and markets." It is essential for both industries to find the most effective wordings and concepts to describe various wood-based materials. Because materials for the building sector often are marketed through specifiers, a better understanding is needed of differences in perceptions between laymen and professionals, eg, interior designers.

The purpose of this study was to 1) identify attributes and associations that people use to describe and distinguish solid wood, wood-based panels, and wood-based composites; and 2) explore how these different attributes and associations relate to preferences for these materials.

Our objective was also to review whether there are differences in perceptions between designers with experience in the use of wood in interior design, and laymen. Our approach was to obtain results about intermediate materials without indicating a final precise application.

ATTRIBUTE ELICITATION

Based on consumer psychology and marketing theory, van Kleef et al (2005) described consumer research methods that are frequently used in early product development. Outputs from different methods include product characteristics, attributes, constructs, and benefits. Product characteristics are measurable physical properties. Product attributes are characteristics that consumers infer from the product, eg, luxury, creaminess, etc. Constructs refer to an institutionalized entity or artifact constructed or invented by a group of people or a culture that exists because people behave as if it exists. Product benefits refer to what the product does for the consumer in terms of pleasant consequences of consuming the product, eg, health, good taste. van Kleef and colleagues argue that a concrete level of consumer needs is most actionable for a product development team, whereas a more abstract level of consumer needs and benefits will be actionable for marketing (eg, advertising). Attribute elicitation methods such as Kelly's repertory grid can be used to identify typical attributes that induce people to discriminate between products. According to van Kleef et al, Kelly's repertory grid is appropriate for marketing purposes because it reveals more abstract consumer needs and values. It is also a suitable method for incremental improvement and product repositioning because the method is mainly product-driven.

A few empirical studies have examined important attributes for the identification, discrimination, and preferences of wood products. Marchal and Mothe (1994) found that the most important factors affecting the appreciation of oak wood were knottiness, cut orientation, tint, and annual ring width. Broman (2000) identified key concepts that impact peoples' attitudes toward wood products. The notions—freshness, harmony, interest, elegance, excitement, restfulness, eventfulness, naturalness, imaginativeness, and absence of gaudiness—reflected the perceived activity and harmony of the surface texture. By external preference analysis, Broman also explored the links between people's subjective descriptions and the physical blend of wood features. Pakarinen and Asikainen (2001) investigated preferences for kitchen cabinets and identified five main dimensions that were important to consumers' choices: environmental friendliness, price, advertising, quality, and style. A survey study by Jonsson (2005) established that aesthetic properties of wood were important factors influencing purchasing decisions by consumers of floor coverings. Using the Q sort methodology, Bigsby et al (2005) discovered that color and grain were key timber attributes that consumers use to form their preference.

Bowe and Bumgardner (Bumgardner and Bowe 2002; Bowe and Bumgardner 2004) studied peoples' word-based and appearance-based evaluations of different wood species. The authors argued that these associations and differentials in the North American context could assist the wood products industry in its market communication. The previously mentioned studies provide evidence that aesthetic and visual attributes of wood materials influence preferences. However, comparisons of perceptions of solid wood and other wood-based materials are scarce.

In a review on attribute elicitation methods in the forest products industry, Brandt and Shook (2005) concluded that, although the research area is expanding, many studies have failed to apply established elicitation methods that can provide consistency in attributes. Instead, the attributes used in the research are often based on anecdotic information, literature reviews, and/or expert panel opinions. This, Brandt and Shook mean, risks biasing the results resulting from the exclusion of important attributes.

The consumer research literature provides a range of preference analysis methods that has been used successfully in other product areas (Aaker et al 2000; van Kleef et al 2005).

MATERIALS AND METHOD

Kelly's Repertory Grid

Because the main purpose of this study was to analyze how respondents perceive, distinguish, and prefer alternatives among wood, wood-based panels, and wood composite materials, Kelly's repertory grid technique (RGT) was chosen as a method (Kelly 1963). Kelly's repertory grid is generally used to investigate the attributes and constructs that people use for distinguishing between different samples. "Kelly's repertory grid is a personal interviewing technique used to elicit the constructs by which consumers structure and interpret a product category. Attributes are elicited by repeatedly confronting a respondent with triads of products drawn from a large set and asking which two products are alike and different from a third" (van Kleef et al 2005). The instructions for attribute elicitation can specify a specific attribute or it may be left to the testers to decide which characteristics and attributes they think are important (Donderi 1988; Bonebright 2001). In practice, the aim of the RGT study is normally to achieve 8 to 12 constructs or attributes per interview (Jankowicz 2004). The elicited constructs are subsequently presented as scales for the subject to rank the samples, first for the samples of each triad and subsequently for the rest of the samples.

The method enables the researcher to elicit and assess individual or group views on different phenomena. As such, it is a combination of qualitative and quantitative techniques, emphasizing the ideal of minimizing the influence of the researcher on the results; it should be "uncontaminated by interviewer's own viewpoint" (Jankowicz 2004). As a result of the precision that is possible to obtain with this method, it can be used for many different purposes, eg, for comparing the views of different persons or what Kelly, the founder of the technique, called "constructive alternativism" (Kelly 1963), which means that subjects' views on phenomena can be compared over time. The technique can also be used for analyzing what is common regarding views of different subjects and for further content analysis of a number of repertory grids by inferring core categories as done in this study. The core categories can include several of the constructs elicited from the formalized interviews with the subjects.

In the study, participants were individually presented with three wood samples at a time (triads) and asked to describe the attributes in which one of the samples was different from the two others. This process assumes that individuals develop their own personal list of attributes that they use to organize and conceptualize differences and key features.

The Samples

The nine samples were chosen to represent natural wood, wood-based panels, and wood-based

composites. The selection was done subjectively by the researchers to achieve a variation in pattern, contrast, fabrication process, traces, representation of the wood material, and aesthetic considerations (Table 1). Many materials can be used as visible surfaces in houses and furniture. Although OSB is mainly used for nonvisible structural purposes, it can be selected for exposed applications, eg, in stores. Some architects even advocate the principle that materials should be shown in their genuine and authentic form (Nylander 1999). OSB was also selected because of its intermediate position between solid wood and more processed forest products. The wooden samples all measured 400 × 135 × 20 mm. The materials, OSB, BeachPlank® (OFK Plast AB, Karlskoga, Sweden), and wood composite were not available in the same thickness, and Kareline® (Kerline OY, Joensuu, Finland) and cellulose composite measured 300 × 50 × 7 mm and 150 × 105 × 5 mm, respectively. Because our study focused on the perceived differences between the samples, we used "plain" material pieces to avoid association to any specific application such as flooring, furniture, or decorations. The surfaces of the wooden samples were planed and sanded, and the wood pieces did not contain knots.

The Respondents and Interviews

The interviews in this study were carried out with 15 subjects, 8 men and 7 women, between 25 and 67 yr old. Five of the participants had a profession within design. The remaining 10 subjects were purposely chosen to represent different backgrounds, ages, professions, and genders.

The general aim of the study was explained to the subjects, and the samples were presented to them in triads. The interviewees were asked to examine (look at and touch) the samples. For each triad, they were asked to state how two of the samples were more similar in one or more characteristic(s) or attribute(s), which contrasted them from the third sample. One or more bipolar attributes were accordingly created from each triad. The subject was then asked to rank all nine items with regard to the elicited construct(s) or attribute(s) on a 5-point scale in which a score of 5 meant that a sample was perceived to be high on the attribute. During the sessions, no reference was made to any specific application (a similar approach was chosen by Marchal and Mothe 1994).

This procedure was repeated nine times in which nine different triads were presented to the subjects on the principle that all samples were shown three times and not at any instance together with a sample that had been presented previously. The only preconceived "attribute" for ranking was preference, which was collected from all respondents (Brandt and Shook 2005; van Kleef et al 2005). The assessment was carried out at individual times between 45 and 90 min.

Analysis

The experiment produced a total of 15 grids, one per subject. An example of a single grid from one respondent is shown in Table 2. Content analysis was used to pool and categorize the elicited attributes from all 15 interviewees according to the meaning they expressed using a bootstrap procedure (Jankowicz 2004). The categorizing was first performed by two of the authors individually. By using a matrix, one can depict what is common for the two categorizations and what is not. The initial categorization had an agreement of 72% between the two independent categorizations. Several iterations were subsequently done according to a "negotiating" process whereby new matrixes were presented increasingly more inclusive of agreed-on categorized constructs (core categories) until a consensus categorization was reached.

A principal component analysis (PCA) was performed on the aggregated grid to retrieve the underlying dimensions of the perceived characterizations. PCA reduces the number of dimensions in a dataset by generating principal components or factors. The original categorized core categories have a correlation with the derived

Table 1. *Wood, panels, and composites in the study.*

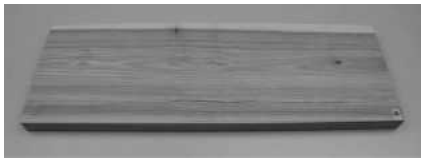
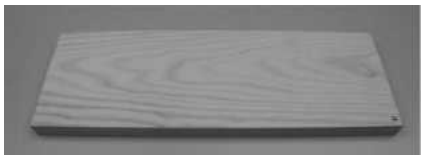
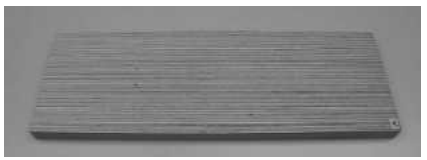
Material	Description	Reasons for choice	Photo
Elm (400 × 135 × 20 mm)	Massive wood	High contrast, grain pattern with parallel lines called vertical grain, lustre, and high density	
Aspen (400 × 135 × 20 mm)	Massive wood	Low contrast, subtle grain pattern, low density	
Pine (400 × 135 × 20 mm)	Massive wood	Grain pattern with a series of long U shapes called a flat grain, loud grain pattern, frequently used in interior applications, traditional	
OSB (Oriented Strandboard) (400 × 135 × 10 mm)	Engineered wood; layered strands of wood in specific orientations	High contrast; can be used as a decorative material according to the producer	
Plexwood® in birch (400 × 135 × 20 mm)	Engineered wood; grain wood and wood with the grain, cross-glued	High contrast, pattern of parallel stripes, decorative wooden product according to the producer	

Table 1. *Continued.*

Material	Description	Reasons for choice	Photo
BeachPlank® (400 × 135 × 25 mm)	Wood–plastic composite out of wood fiber and recovered polyethylene plastic	Homogeneity, high density, surface that is brushed to resemble wood according to the producer	
Kareline® (300 × 50 × 7 mm)	Composite of wood fibers and plastics	A varied surface pattern and an impression of depth and warmth, a natural appearance according to the producer	
Wood composite (400 × 135 × *5 mm)	Composite of wood fibers and plastics (PP)	Appearance as an artificial material, visible sawdust grains, uniform color	
Cellulose composite (150 × 105 × 5 mm)	Composite of cellulose fiber-reinforced polylactide (PLA)	Product under development	

Table 2. *Example of an individual grid from one respondent.*[a]

Attribute	Plexwood®	Elm	BeachPlank®	Pine	OSB	Aspen	Wood comp	Kareline®	Cellulose comp	Attribute
Massive	2	2	1	3	5	3	2	1	4	Brittle
Authentic	3	1	4	1	4	2	5	3	4	Refined
Natural	2	1	5	1	3	1	5	5	3	Plastic
Lively	3	1	5	1	1	4	4	2	4	Dead
Historical	3	1	5	1	3	1	5	4	4	Lack of history
Nice	4	2	5	1	4	1	4	5	3	Mean
Environmentally friendly	2	1	4	1	2	1	4	5	3	Not environ. friendly
Wood feeling	2	1	5	1	2	1	4	5	4	No wood feeling
Like	2	1	5	2	3	1	5	3	4	Do not like

[a] 1 = attribute to the left, 5 = attribute to the right.

principal components/factors called factor loadings and the samples have values on the principal components/factors called factor scores. The factor loadings are useful when interpreting the factors, ie, the underlying psychological dimensions that the interviewees used to describe the materials, and the factor scores show the relative positions of the samples on these factors.

RESULTS

The Core Categories

The elicited attributes/constructs were grouped into 19 categories. Table 3 shows an overview of the categories. The designers mentioned constructs related to the feeling of wood and the naturalness of the material in 43% of the cases (24.3% ± 18.9%). The third largest category for the designers was related to the evaluating characteristics of the material, 10.8%. For laymen, the distribution of constructs is more scattered among the categories; constructs related to wood and naturalness were mentioned in 22% of the cases and the third largest core category is "patterned."

A difference was also noticed between the professional designers, who provided proportionally less pure sensory core categories (24%) and more interpretative core categories (62%) and the laymen, whose core categories concerned more sensory attributes (53%) and, to a lesser degree, interpretative core categories (40%) (Fig 1).

Mean Values for Each Wood Piece per Construct

A mean rating on each category generates a repertory grid shown in Table 4. It provides a profile of how each sample was perceived by the respondents regarding each of the core categories. It constitutes an overview of perceived similarities and differences between the products.

Table 4 shows a set of core categories in which solid wood received high ratings: naturalness, wooden impression, and value. It also reveals that composite samples scored high on processed and hardness. Solid wood was generally most preferred.

Principal Component Analysis Results

A PCA was performed on the aggregate results from Table 3 with the categorized constructs as variables and the materials as cases. Preference was also included in the factor analysis. Three factors had eigenvalues larger than 3. The first two factors explained 65% of the variation in the data set. Adding one more factor increased the explanatory power to 80%. Considering that the number of samples tested is only nine, a 2-D solution is appropriate. However, with the aforementioned reservation in mind, a third dimension could still add interesting considerations for our analysis and also suggests themes for further research. In Figs 2 and 3, the factor loadings for the projection of the variables on the first three

Table 3. *Content analysis.*[a]

Category	Definition	Designers (N; %)	Laymen (N; %)	Total (N; %)
	Interpretative core categories: Material			
Wood	Looks, smells, and feels like wood; not artificial; "wood feeling"	9; 24.3	7; 8.0	16; 12.9
Natural	From nature; natural, looks natural; not plastic; real	7; 18.9	12; 13.8	19; 15.3
Living	Living material, reflects light in living way	1; 2.7	3; 3.4	4; 3.2
	Interpretative core categories: technical			
Processed	Processed material/wood pulp, difficult to work up, produced	3; 8.1	4; 4.6	7; 5.6
Stable	Stable, technically reliable, durable material	1; 2.7	3; 3.4	4; 3.2
Homogeneous	Homogeneous, uniform, original solid material.	2; 5.4	6; 6.9	8; 6.5
	Sensory core categories: visual			
Patterned	Much variation, complicated surface, patterned, visual structure	2; 5.4	8; 9.2	10; 8.1
Irregular pattern	Organic, irregular, no order, round shapes	0	6; 6.9	6; 4.8
Calm	Not vivid surface and calm pattern; calm	0	3; 3.4	3; 2.4
Bright	Light, light color	1; 2.7	7; 8.0	8; 6.5
Color	Pleasant color	0	2; 2.3	2; 1.6
	Sensory core categories: tactile			
Warm	Warm, warm expression	1; 2.7	1; 1.1	2; 1.6
Weight	Heavy	1; 2.7	6; 6.9	7; 5.6
Solid	Solid, sounds solid	2; 5.4	2; 2.3	4; 3.2
Hard	Hard, compact	0	4; 4.6	4; 3.2
Smooth	Smooth, smoothness	1; 2.7	5; 5.7	6; 4.8
Sleek	Slippery	1; 2.7	2; 2.3	3; 2.4
	Value			
Pleasant	Kind, harmonic, pleasant, safe, cozy	1; 2.7	4; 4.6	5; 4.0
Worth	Historical, traditional, ordinary, not trendy	4; 10.8	0; 0	4; 3.2

[a] For each category, the definition and the number of attributes belonging to that category are shown for designers (n = 5), laymen (n = 10), and the sum in total (n = 15). Below each number is given the percentage of attributes belonging to that category.

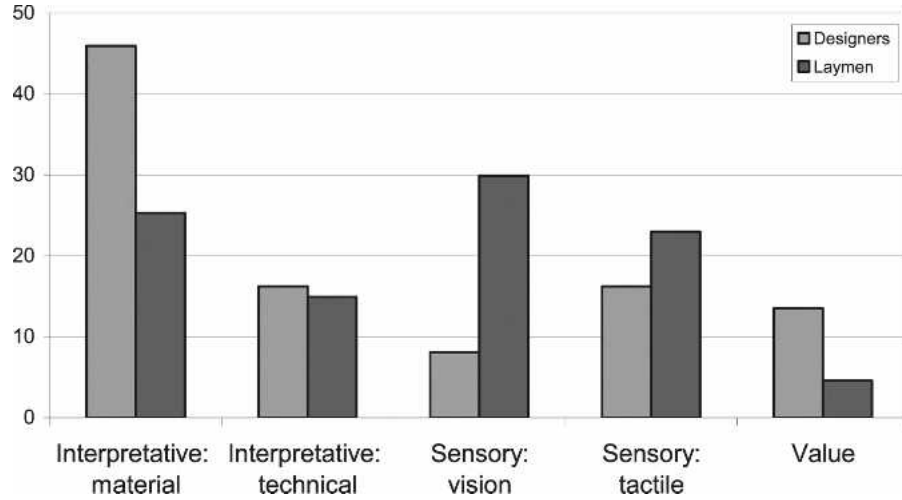


Figure 1. Distribution in percent of elicited attributes between core categories for designers and laymen, respectively.

Table 4. *Repertory grid showing mean ratings on core categories.*

Elm	Aspen	Pine	Kareline®	Plexwood®	Cellulose composite	Beach Plank	OSB	Wood composite	
5	5	5	2	4	3	1	4	2	Wood
5	5	4	4	4	3	2	3	2	Preference
5	4	5	4	3	2	2	4	3	Living
4	5	4	4	2	3	4	2	3	Homogeneous
4	3	4	4	4	1	3	5	3	Varied pattern
5	5	5	3	3	3	3	1	2	Emotion
5	4	4	3	3	2	4	2	2	Stable
4	4	4	5	3	4	1	1	3	Smooth
5	5	5	2	3	2	2	3	1	Natural
3	1	1	5	3	4	5	3	5	Hard
3	5	3	2	4	5	4	1	2	Calm
4	5	5	1	3	2	2	4	3	Bright
4	5	4	2	3	5	2	2	1	Good color
4	3	3	4	3	2	5	2	3	Solid
4	3	4	1	3	3	3	4	3	Warm
1	1	1	5	3	4	4	3	4	Processing
4	3	2	3	3	2	5	3	3	Weight
2	2	3	4	1	3	2	4	3	Irregular pattern
4	4	5	1	3	2	2	3	2	Worth
2	2	3	4	1	3	2	1	2	Sleek

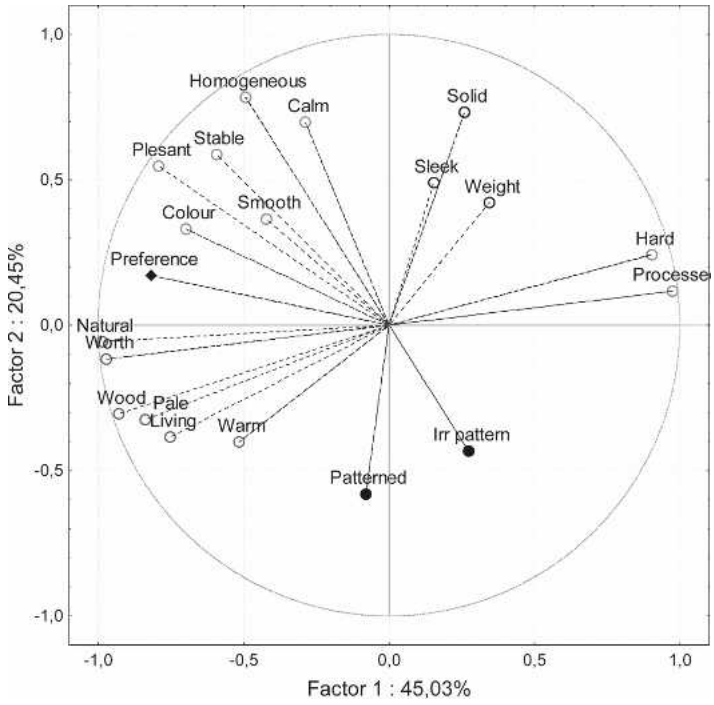


Figure 2. Principal component analysis results and factor loadings. Factors 1 and 2.

principal components are plotted. Factor loadings (unrotated) are given in Table 5. The first principal component explains 45% of the variation, and we interpret this factor to represent the natural aspects of the material (natural, unprocessed, worth, wood-like, soft, pale, pleasant, and

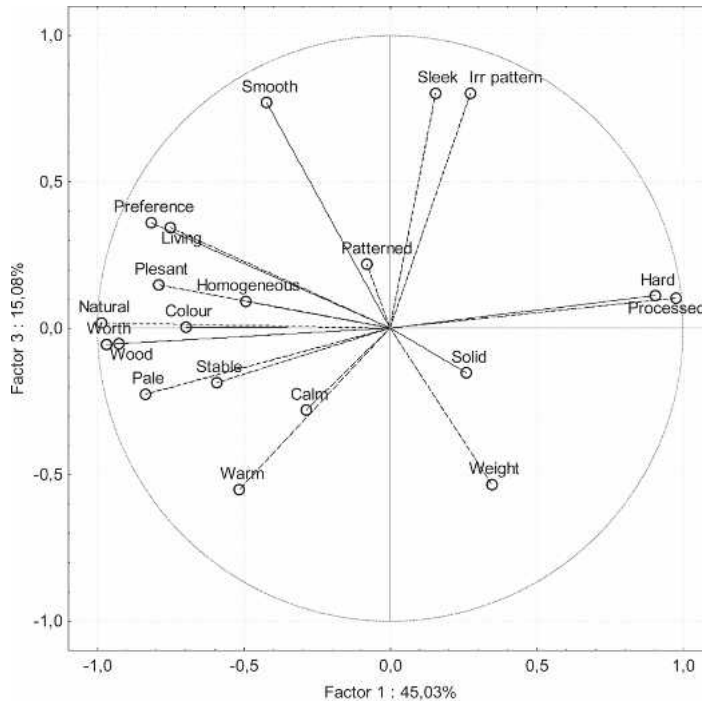


Figure 3. Principal component analysis results and factor loadings. Factors 1 and 3.

living). This component distinguishes between the wooden samples and the composites with the panels placed in between as can be seen in the factor score plot in Fig 4. The second component separates samples according to solidity and homogeneity (homogeneous, solid) (Fig 2; Table 5). The factor score plot (Fig 4) shows that the second principal component mainly separates the inhomogeneous and fragmented OSB and the homogeneous and solid BeachPlank® from the intermediate samples. The third factor represents the degree of smoothness, sleekness, and irregular pattern (Fig 3). This third provisory dimension separates Kareline®, mainly from the brushed BeachPlank® (Fig 5).

Preferences

The respondents rated all nine samples on a 5-point category scale according to their preference. Average preferences for the samples are presented in Fig 6. It shows that the solid wood samples are the most preferred. BeachPlank® and the wood composite were the least preferred alternatives.

A summary representation of the correlations between attributes and preference ratings is shown in Fig 7. The preference ratings correlate with the core categories pleasant, natural, wood-like, smooth, living, and worth. Preferences correlated most negatively against the attributes processed, hard, and high weight. Furthermore, an examination of factor loadings (Table 5) informs us that preference is mostly associated with the first principal component (factor loading 0.82), but it has some association also with the third dimension (factor loading 0.36).

We conclude that wood is generally preferred because of its natural and unprocessed properties. Effectively, several respondents provided a specific attribute referring to "wood-likeness" that correlated strongly with preferences. The composites were less liked and were perceived as unnatural, processed, and unlike wood. The difference in preference between the moderately

Table 5. *Principal component analysis results, factor loadings.*

	Factor 1	Factor 2	Factor 3
Wood	**−0.928**	−0.306	−0.053
Natural	**−0.987**	−0.058	0.019
Hard	**0.904**	0.242	0.111
Processed	**0.976**	0.118	0.104
Living	**−0.751**	−0.385	0.345
Pleasant	**−0.791**	0.547	0.148
Worth	**−0.971**	−0.116	−0.054
Homogeneous	−0.494	**0.784**	0.093
Solid	0.260	**0.732**	−0.153
Patterned	−0.081	−0.580	0.219
Irregular pattern	0.273	−0.433	**0.803**
Smooth	−0.422	0.366	**0.771**
Sleek	0.153	0.489	**0.803**
Weight	0.346	0.420	−0.533
Pale	−0.837	−0.324	−0.224
Color	−0.698	0.331	0.005
Calm	−0.286	0.697	−0.279
Warm	−0.515	−0.402	−0.549
Stable	−0.594	0.587	−0.185
Preference	**−0.817**	0.171	0.362

Factor loadings > |0.7| in bold. Consumer perceptions and preferences on solid wood, wood-based panels, and composites—a repertory grid study.

preferred Kareline® and the disliked BeachPlank® could be explained by differences on dimension 3, where smoothness was a core category.

DISCUSSION

Perceptual attributes distinguishing pure wood materials from wood-based panels and wood-based composites were identified. The respondents used tactile and visual impressions to define attributes to describe and differentiate the different pieces. Important elicited attributes in this respect are natural, unprocessed, worth, soft, pale, pleasant, and living. We also identified a specific construct, which the respondents defined as wood-likeness. The principal component representing unprocessed, natural, living, and wood-likeness is furthermore highly associated with preferences. Composites, on the other hand, were described in terms of artificial (as opposed to wood-like), processed, unnatural,

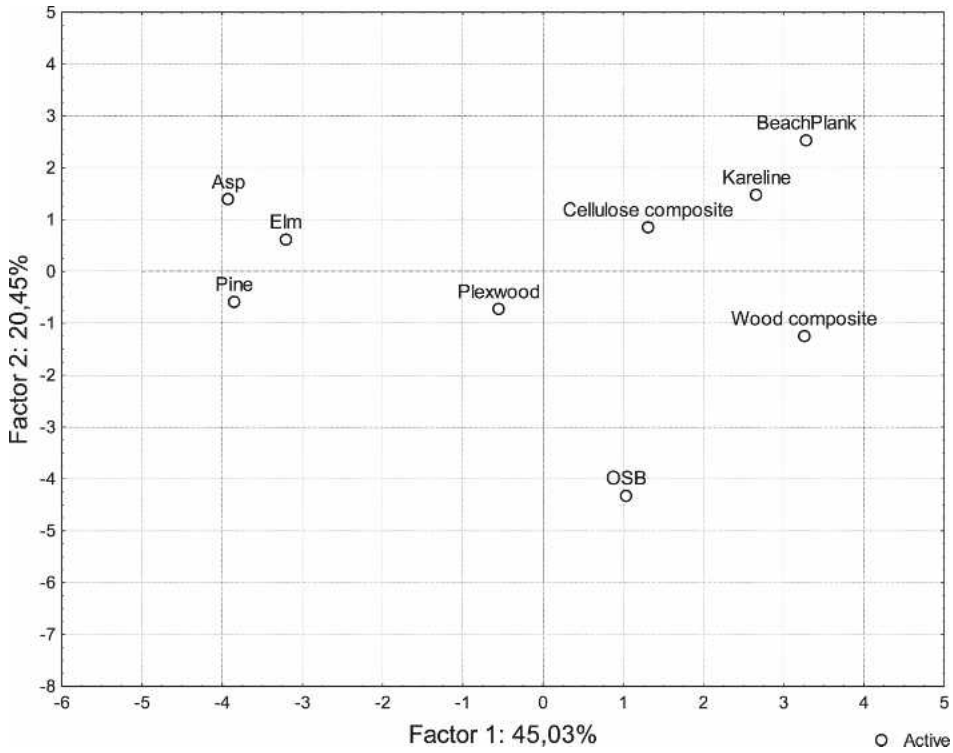


Figure 4. Factor scores. Factors 1 and 2.

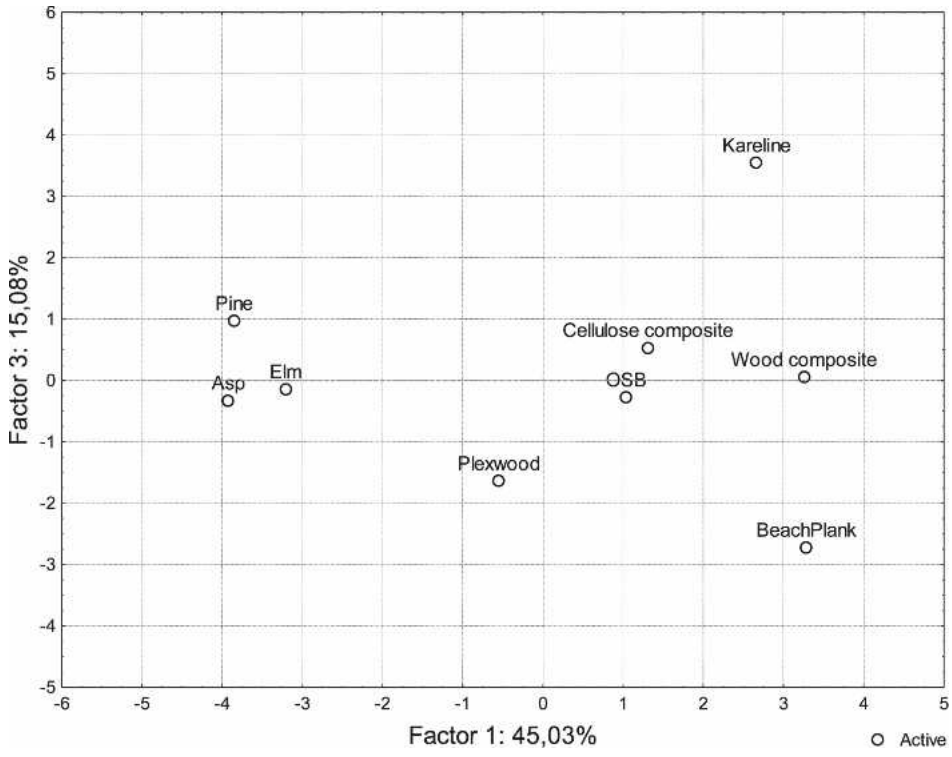


Figure 5. Factor scores. Factors 1 and 3.

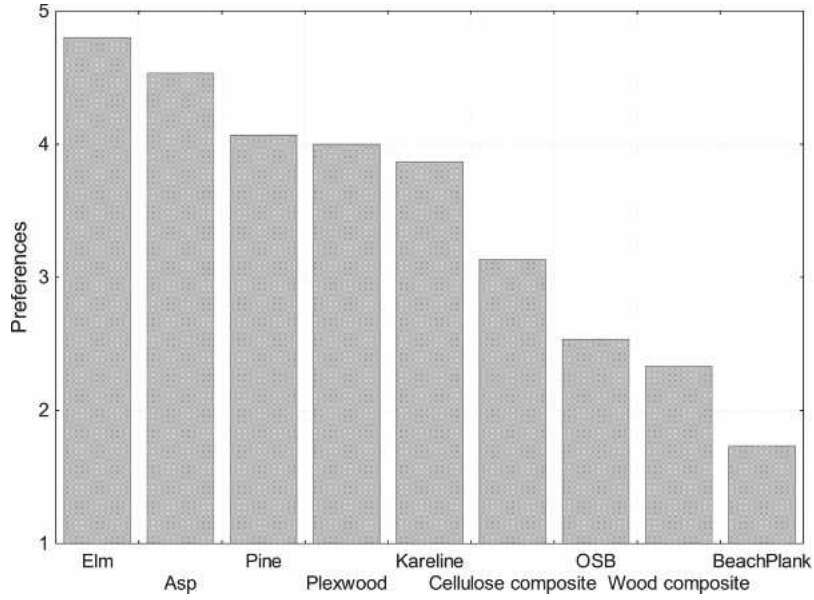


Figure 6. Average preference ratings (n = 15) for each sample (1 = do not like at all, 5 = like very much)

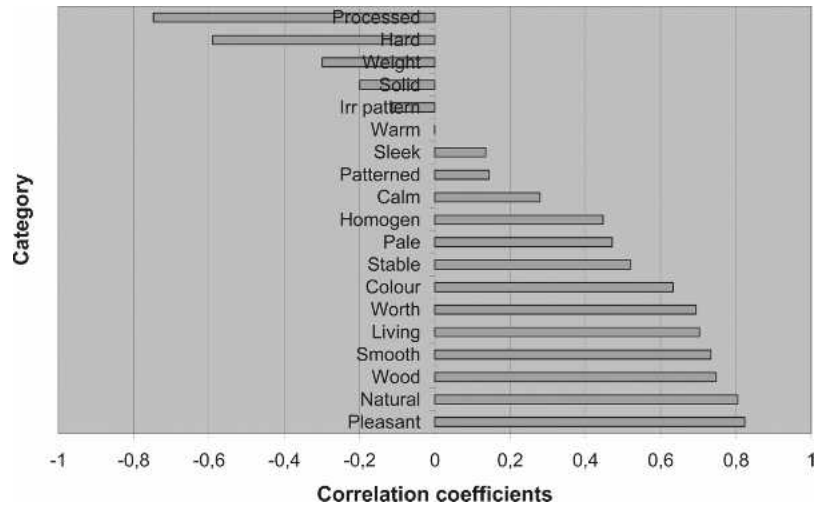


Figure 7. Correlations with preference.

and hard. Panels (Plexwood® (Plexwood products, Utrecht, NL) and OSB) were placed between natural wood and composites with regard to this factor.

Although the scope of our study differs from Broman (2000), we can confirm that appreciated properties of wood are connected to its natural origin and wood-specific properties combining harmony and activity without disturbing irregularities. This relation was also found by Nyrud et al (2008).

A second principal component separating the samples represents homogeneity and solid impression, and a third provisory principal component corresponds to sleekness, smoothness, and irregular pattern. Although the first principal component distinguishes wood from composites, the second and third principal components present larger differences within the composite samples than within the wood samples or between wood, panels, and composites.

The elicited attributes and associations probably depend on a person's education and profession. Our study indicated that designers more often mentioned the wood-like properties and naturalness of wood than laymen. Designers were also more often using interpretive characterizations, whereas laymen frequently used sensory concepts.

The outcome of this study provides indications for the product and material development. It helps R&D units to discern between the attributes to develop and which to avoid. We also show how preferences are associated with different interpretations and value attributes. Producers of solid wood products should manufacture products in which the natural origin is emphasized. This means that they should present the positive aspects of unprocessed wood, the living structure, and nice color, its naturalness, etc. Moreover, market communication efforts could use characteristics and attributes with positive correlations with preference in its promotion efforts stressing attributes like naturalness, low degree of processing, living surface, etc. One option for producers of wood-based composites would be to manufacture products that show a greater likeness to solid wood products. This includes giving them a more "living" surface resembling the typical wooden surface and reducing hardness and weight. However, it appears to be difficult to imitate natural surfaces. This is shown by the fact that although the producers of both BeachPlank® and Kareline® claimed to supply products with a natural ap-

pearance (Table 1), both these composites received low mean ratings on the naturalness construct (Table 4).

Although the natural character of solid wood is difficult to imitate in composites, it may be more fruitful to inform customers about the positive environmental aspects of composites that connect strongly to their wooden origin. However, it is also worthwhile to explore other popular attributes than those that are typical for solid wood. Figure 3 shows a slight preference toward smooth surfaces, which in our case may have increased the popularity of Kareline® in relation to, eg, BeachPlank® (Fig 6). There is an opportunity to develop wood-based composites with a smooth surface that would be well-perceived. This could be supplemented by promotion campaigns emphasizing the material's natural origin.

Despite the qualitative approach, the quite small number of respondents must be considered as a limitation of this study. Further studies could use larger populations to compare different subgroups based on profession (structural engineers, architects, builders) or socioeconomic factors. To keep our enquiry on a "generic" level, we chose not to refer to any specific application (eg, flooring or furniture). Continued studies could probe more into how the application and context may impact both preferences and perceived attributes (Marchal and Mothe 1994).

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