

# Perception of naturalness in materials and user's choice: hardwood and melamine foil finished products

Frederico Mendes Teixeira <sup>a</sup> | Andréa Franco Pereira <sup>a\*</sup>

<sup>a</sup> Departamento de Tecnologia do Design, da Arquitetura e do Urbanismo (Universidade Federal de Minas Gerais): Belo Horizonte, Brazil

\* Corresponding author: andreafranco@ufmg.br

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## ABSTRACT

In this study we have sought to identify the existing relationship between materials perception of naturalness, and interviewee's preferences between hardwood and low-pressure melamine foil MDF products. Prototypes of the same product were built in five different materials: ceramics, hardwood, polyethylene, wood-like décor melamine foil MDF, and aluminum. At first, 30 interviewees from ages 20-60, ranked samples of materials according to a) perceived degree of naturalness and b) preference (hedonic scale). After that, they identified the use of the product (prototype) and chose one, under the criteria of material adequacy. The results have shown that wood and its imitations are the materials perceived as most natural and preferred by the interviewees. However, naturalness is not necessarily the deciding factor upon choosing a product.

*Keywords:* perception of naturalness, product design, wood

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## INTRODUCTION

Material perception of naturalness is an important aspect of product development. It relates to both product technicality and function (emotional and use). Industries have developed materials that imitate natural ones in order to recreate their natural characteristics and apply them to products. Previous professional experience acquired in a fiberboard industry allow to understanding the interest of this sector to invest in the search for new patterns and designs that meet a demand for the natural aspect on products and also to invest in advanced technology so their wood décor foils are closely similar to natural wood, both visually and tactilely. It was possible to identify that there is an interest by a large part of designers and architects in using in their projects patterns that resemble solid woods, stones and fabrics. Despite some regional features, there is always a search for patterns that approximate the textures of natural materials. From these experiences, questionings about the relevance of the naturalness of the materials and how user's choice have motivated this research. Thus, it is considered that the understanding about this process of user choice is important for the

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decision regarding the selection of material specifications according to users' expectations and fundamental for the industries to develop products with greater chance of success in the market.

Several researches have already focused on the subject of users' perceptions regarding the properties of materials in their visual (Fleming, 2014; Crilly *et al.*, 2004), tactile (Moraes and Pereira, 2015; Kergoat *et al.*, 2012; Tiest, 2010), auditory or multisensory (Fujisaki *et al.*, 2015) aspects. However, few deal with the understanding of the perception of materials concerning their naturalness.

Natural materials are usually valued more favorably by users as they are associated with well-being and health, and evoke feelings that go beyond their technical aspects of hardness, thermal conductivity, color, texture, malleability etc. Users' preference towards naturalness is associated with subjective, emotional, cognitive and affective matters (Goodman *et al.*, 2008; Overvliet and Soto-Faraco, 2011). This occurs especially because of the biophilia principles (Rozin *et al.*, 2004), that are defined as the psychological tendency presented by humans to feel attracted to everything that is alive and organic (Simaika and Samways, 2010; Wilson, 1984, Daniel, 1990).

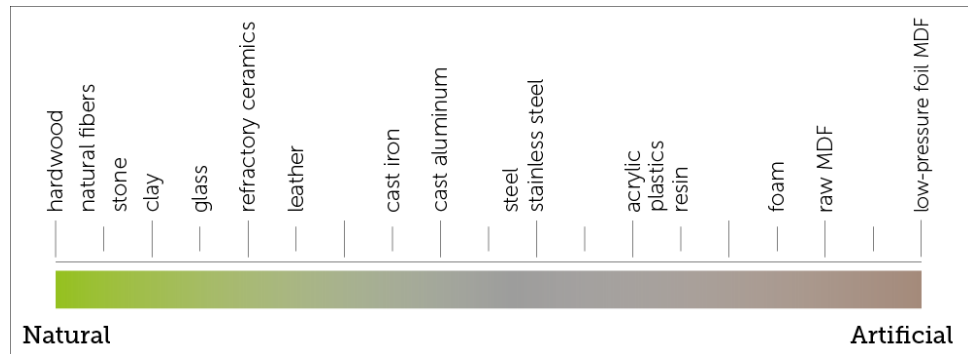
The main sensory parameters for naturalness of materials are touch and vision. Upon observing the visual textures, tactile textures, colors, roughness, white light reflection, hardness, and temperature, users are capable of classifying a material as more or less natural. However, these parameters may change when a material is applied to a product, since there are other aspects to be considered such as product weight, adequacy of the use functions, ease of use, ergonomics (objective aspects), product meaning, and the interviewee's memory and experiences (subjective aspects). Material choice can render products technical superiority and the creation of intangible aspects can enhance the products quality. Although the choice of material is adjusted to enhance a products value, it is only effective should the product be well designed and in accordance to users' expectations (Karana *et al.*, 2009).

This research sought to understand how material perception of naturalness influences users' choice when selecting products. The objective was to answer questions as: Are the materials perceived as more or less natural based on visual and tactile aspects? Is wood perceived as the most natural material and the users' preferred material? Are metals and plastics perceived as the most artificial materials? Is the use of a product defines materials' choice?

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## 1. METHODOLOGY

Initially, a bibliographical review was made concerning the perception of design and the perception of naturalness. A scale of naturalness (Figure 1) was proposed, based on the materials' processes.



**Figure 1. Scale of Naturalness.**

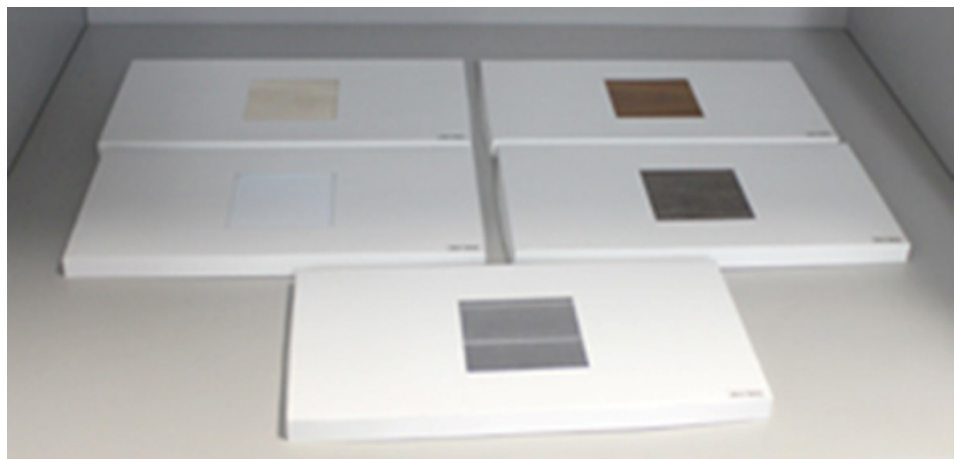
This scale of Naturalness was included in this work in order to serve as a reference tool for the positioning of materials in a range between the natural and the artificial. Its construction was carried out on the basis of: a) on the concepts of Wilson's biophilia (1984), which defines that users seek, intuitively, a connection with nature or that which is closely related; b) in the productive processes in which raw materials were submitted until reaching the applicable material for the construction industry and consumer goods; c) on the concepts of naturalness and artificiality presented by Rozin and others (2004) and Manzini (1993), which defines the industrial processes in which the raw material pass that influences the impact of users' perception of naturalness.

The research procedures were made based on the standard NBR 13170 - Sorting Tests in Sensory Analysis (ABNT, 1994). This standard allows a sampling to order the intensity of a certain attribute of a product, in this case, the naturalness. It also allows sorting it by preference. The standard recommends that the tests should be applied in rooms where the tasters can perform them individually. The ambient temperature should be pleasant and free from external interference. The tests were applied in the Laboratory of Integrated Studies in Architecture, Design and Structures (LADE) at the Universidade Federal de Minas Gerais (UFMG) which has a cabin for performing sensorial tests that meets the requirements of the standard. The standard also provides an evaluation form. The tests were performed following this form.

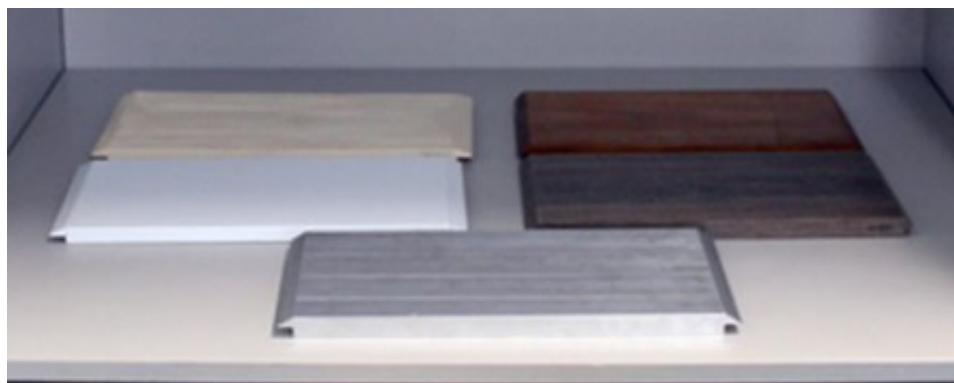
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Fieldwork was then conducted with a sample of 30 interviewees. The NBR 13170 (ABNT, 1994) defines that for ordination tests the minimum sampling is 15 interviewed. Preference tests performed in the laboratory should be done with at least 30 interviewees. Hertzog (2008) points out that pilot surveys should not exceed a sample of 40 individuals and that the time required to conduct interviews, costs involved etc. should be considered. Thus, the sampling defined for this study was  $N = 30$  ranging in the ages of 20-60.

Firstly, they ranked 5 sample materials (Figure 2) – ceramics, hardwood, aluminum, polyethylene and wood-décor foil MDF – according to a) their perception of naturalness and b) personal preferences (hedonic scale). The results of the rankings were compared through analysis of the frequency for each response/classification. Secondly, interviewees were presented with a prototype (Figure 3) made in the same 5 materials and evaluated their functions and selected their preferred products based on their material.



**Figure 2. Material samples.**



**Figure 3. Prototypes.**

As to analyze the interviews during the fieldwork, 5 prototypes (Figure 3) of the same product were made in different materials. The products were presented in a way that was simple enough to be constructed in different materials and allow interviewees to manipulate them freely and identify a function for each product. The purpose for making the same product in different materials was so that users would be able to make their decisions based solely on material, not on any other product attributes. All 5 materials were presented on the Scale of Naturalness (Figure 1). Hardwood and MDF were selected for representing both ends of the scale. Ceramics were chosen for being closely related to the idea of naturalness; plastics for being closely related to the artificial; and aluminum for representing the middle of the scale. Besides these previously described factors, these materials were chosen considering how easily they could be obtained, accounting for the deadline, and financial resources allowed for the research.

The interviewees were invited through various means including e-mails, social networks, and personal invitations to personal in the Belo Horizonte, Brazil. Interviewees had to meet the following profile: a) being in between the ages of 20-60; b) being in conditions to be able to use their hands and fingers in order to manipulate objects (no wounds, numbness, or lesions that could impede in the handling of small objects); c) Not having a degree in architecture, design, interior design, decoration, engineering or any other discipline that is related to material theory and techniques. After being selected, interviewees were instructed to go to LADE/UFMG on the weekdays, between 8:30 a.m. and 1:00 p.m., as these are the hours when the laboratory experiences less external interferences, is quieter, and presents better environmental conditions. All tests were taken individually. According to Guinard *et al.* (2001), although a sampling might be heterogeneous, lab tests of preferences that involve more than one sensory variable (in this case, touch and sight) present good enough results if tests are taken individually. This technique also allows for objective results, as the data analysis is assertive and interviewees feel more comfortable to express their opinions, without being influenced by other people. Additionally, perception and preference are individual concepts that underlie personal satisfaction and individual values (Kaplan and Kaplan, 1989).

According to Ode *et al.* (2009), perception of naturalness can be measured in scales through observation of object's physical attributes and touch. In this light, at first, material samples were presented in boxes of 38 cm x 20 cm, with a cut out mask of 10 cm x 10 cm on the top central portion so that interviewees could see and touch them (Figure 2).

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The first instruction given was that they were to rank materials according to their degree of naturalness, being *1 – Most Natural* and *5 – Most Artificial*. Interviewees filled in the forms with the codes presented on each sample material (Figure 4).



**Figure 4. Naturality ordering tests.**

Codes are described in Table 1.

**Table 1. Material samples and codes**

Sample code	Material sample
Am 001	Ceramics
Am 002	Hardwood (Cedar <i>sp.</i> )
Am 003	Wood décor foil MDF
Am 004	Polyethylene
Am 005	Aluminum

After, interviewees were instructed to rank materials according to their preferences, being *1 – I like the most* and *5 – I like the least*. Just as before, they were asked to record the codes of material samples. All interviewees were able to make both ranks. The answers were compiled on a spreadsheet.

Secondly, interviewees were asked to remove the white boxes, revealing the prototypes built in 5 different materials (Figure 5). They were instructed to manipulate the objects freely. Afterwards, they were presented with the question “What is this object?”. The associations were free. The purpose of this question was for the users to decide the use of each object, not being influenced by the materials. The final and following stage was to choose their preferred product out of the 5.

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**Figure 5. Identification and product reference tests.**

## 2. DESIGN AND PERCEPTION

Knowledge of perception merits great attention for both scientific and practical matters. From a scientific point-of-view, perception is essential to the study of cognitive and emotional functions of human beings. On the other hand, from the practical point-of-view, perception assists in the development of products to present a decent amount of information for the use of the consumer (Rossi and Berglund, 2011).

Upon mentally observing a product, people include their memories and experiences, and immediately establish general opinions concerning that object. It is also an intuitive process, where users question the object's functions, values, etc. (Ostrower, 1990).

Designers can use this information and act as messengers delivering codes with each design influencing users' preference towards a product. Designers must utilize materials according to users' interaction with that particular product making use of the 5 senses: touch, smell, sight, taste and sound. People will then use sensory properties to ascribe meaning to materials and the product itself (Karana *et al.*, 2009).

According to Hekkert (2006), design must attend to the four basic principles so that the user is capable of evaluating a product. The four principles are: 1) "maximum effect for minimum means", in which the user uses little effort to quickly evaluate a product; 2) "unity in variety", which means there is a benefit to making connections between parts of a product, identifying order and clarity as a whole; 3) "most advanced, yet acceptable" indicates that users prefer a high degree of familiarity in a certain category of products; 4) "optimal match", in which products must simultaneously address more than one sensory property.

Perception in design usually occurs through the senses of touch and sight (Crilly *et al.*, 2004; Hekkert, 2006). The eyes initially run through the product and make a brief recognition of



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materials, shapes, and colors and allow the user to make quick judgments of the product, called aesthetic impression by Crilly *et al.* (2004). According to Norman (2004), such criticisms occur on a visceral level, when users make their first impressions and hedonic definitions concerning a product.

Secondly, users make physical contact with the product, mainly through the sense of touch (Hekkert, 2006). At this time, one is able to test possible uses for the product, checking its weight, texture, shapes, stability, and other properties (Crilly *et al.*, 2004). These evaluations are made on a behavioral level allowing the user to set new parameters and opinions about the product (Norman, 2004).

Once the senses of touch and sight have been stimulated, others such as hearing and smell are activated, creating a semantic association (Crilly *et al.*, 2004). When this occurs, users connect deeper with the product and there is a stronger sense of attachment, stimulated by the recognition of intangible benefits a product might offer (Govers and Mugge, 2004). Users establish a new relationship with the product and recognize that not only can a product bring comfort and security, but also an emotional connection. This is known as the reflexive level (Norman, 2004).

Perception of design therefore relates to both product usage and attachment. In the visceral level, users make hedonic associations based on their very first impressions. On a behavioral level, users make stronger assessments that define whether the product is adequate to its proposed use, and attains to its requisites of durability, quality, resistance, predicted life span, maintenance etc. In the reflexive level, users can identify other attributes, concerning fondness, status, memory and a recognition of self in the object.

### 3. PERCEPTION OF NATURALNESS

Human beings have strong ties and great respect for nature. Although there might be cultural, social and economic differences, the preference for nature is inherent to every human being due to the principles of biophilia, an interest in exploring the basic senses of attachment towards what is natural (Silva and Farbiarz, 2017; Rozin *et al.*, 2004; Wilson, 1984; Maller *et al.*, 2005; Daniel, 1990).

Naturalness is defined as the possibility of an entity being perceived as natural or derived from nature. It is an asset associated with a positive feeling and is likely to be a factor of differentiation in users' decision-making process, as well as users' experience in material interface (Goodman, 2011).



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Perceptions of naturalness and preference for natural materials are not related to technicality. It is a subjective factor and inherent to all humankind. It is not directly related to primary human needs, but the search of a generalized aesthetic that is part of all of us. The characterization of naturalness and its relation to quality are not solely connected to technical material information, but also includes users' knowledge, understanding of risk factors, and perception (Evans *et al.*, 2010; Rozin, 2005; Kaplan and Kaplan, 1989).

Rozin *et al.* (2004) accounts for two categories of preferences for the natural, with six basic principles. The first category is called "Instrumental" and refers to functional superiority of natural entities, presenting greater focus on their technical performance. The second category is called "Ideational" and refers to moral and aesthetic values of materials.

In the Instrumental category, there are four principles: a) human intervention causes damage to nature, so natural materials have suffered less damages as they have been through less contact with such interventions; b) natural materials are healthier, as they present virtues in their original state; c) the properties of natural material are more pleasant, therefore, most likely to be to users' preference; d) natural materials are purer, they have been through less contamination and are safer.

As for the Ideational category, the two principles are: e) normative order, which means natural materials came first, prior to human intervention, so there is a moral connotation of respect for having existed longer; f) natural materials are inherently better and morally accepted, thus better than artificial.

Users recognize that materials applied to a product have been through modifications and processing, meaning that there are other decision-making criteria upon purchasing these products, contemplating perception of naturalness plays a large role in this decision. In other words, although users may claim preferences for natural materials, meaning the material has been through an adequate process to consider use, still, users may present a preference for practical materials over natural ones.

Material specifications refer to several issues that involve more than just perception of naturalness. According to Van Kesteren *et al.* (2007), material selection in design determines both tangible aspects of products, such as durability and costs, and also intangible aspects, such as emotional and symbolic attributes of the product, memory etc.

Material perception of naturalness must attend to the following principles:

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- Understanding of material as natural or derived from nature;
- Material that has been through as little human contamination as possible in its physical-chemical process;
- Material that is lively;
- Material that is purer and safer;
- Use of raw material in its purest form;
- Material with moral superiority, therefore, inherently acquiring a higher quality;
- Material with minimum influence of human contact during production;
- Material with similarity to natural entities, both in the aspects perceived by the senses and the quality of the product;
- Materials that give a sense of attachment for natural entities (the biophilia principle).

Users' preferences for products with naturally perceived materials must attend to the following criteria:

- Satisfaction of basic user needs for utility, safety and comfort;
- Pleasing appearance, satisfaction of emotional and symbolic attributes;
- Determination of functionality, durability and costs;
- Reaching maximum effect for minimum means, presenting product information by the clearest and most straight forward means possible;
- Being logical and sufficient in all parts;
- Understandable in shape and intuitive in use;
- Addressing to more than one sensory property simultaneously;
- Recognizable by users.

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#### 4. MATERIAL NATURALNESS

To understand the principles enlisted earlier in the study, it is important to create a scale to measure material naturalness. This scale was based on the observation and generalized grouping of materials used in design and construction.

Materials applied to the building and construction industry are diverse and present variations within larger groups of materials. Plastics, for instance, contain a wide variety of types: polyethylene, polypropylene, polyvinyl chloride, acetate etc. Like plastic materials, hardwood can be found in many forms as well such as eucalyptus, pine, and cedar amongst others.

According to Manzini (1993), a material is something that under certain conditions behaves in a determined manner, meaning that it can have a variety of outcomes. Thus, each material will be more or less adequate to perform a specific function in a particular product: provide protection, structure, finishing components etc. Some surfaces are able to 'elude' consumers by imitating another material or different finish. This can create function, contrast between colors, or it can simply "dress up the same product in different clothes" (Ashby and Johnson, 2003). Imitations of natural materials aim at enhancing a products value, attracting users who value naturalness to a given product.

In this light, a scale of naturalness is proposed and presents materials put together in more global and general group of classifications (Figure 1). The scale presents materials from the most natural to the most artificial. The scale starts on the left-hand side, where most natural materials are presented. As the scale moves to the right, materials are considered to be more artificial, becoming more homogeneous and easier to be manufactured by industrial means with higher volumes of production.

The minimum part used to construct the Scale of Naturalness are processes through which a material goes through whilst being transformed from raw-material to industrial material, as well as elements involved and undertaken in physical-chemical transformations. It is worth mentioning that such scales can undergo modifications and are used in this work as a tool for further analysis of perception of naturalness of materials and users' preferences of products. Other criteria may be taken in consideration concerning this scale and might be used in the future, such as molecular structure of materials, or individual complexity of each industrial process used for making material, or even recyclability and the after-use aspects of materials. However, as the main focus of this work is perception, the scale was created from

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materials that are closer related to the senses of sight and touch, with the aim of representing a reference for future analysis.

Hardwood is, in fact, the material in which one can identify a higher degree of naturalness or perception of such. It is frequently used in a wide range of products such as furniture, cutlery, civil construction etc. According to FAO (2010), the consumption of wood in the world has a probability to continue to increase due to demographic changes in inflations in populations and the political need to control energy and renewable resources. Wood is considered an environmentally friendly material; with favorable energy equilibrium since it is renewable and contains carbon, which helps control the continuing climate changes.

Besides these technical aspects, wood is the most pleasing material to people because of particular characteristics such as smell, surface smoothness, low thermal conductivity, and its visual aspects. It is a material that brings up feelings of comfort and well-being (Pereira, 2013).

An interesting finding concludes that the more artificial the material, the more it resembles natural ones. Take low-pressure foil MDF, for instance. The foil industries are constantly seeking to reproduce wood décors that resemble natural wood in design, colors and texture. Manzini (1993) highlights the existence of materials that are “ultra-artificial”, or “almost natural”. These materials are the ones whose manufacturing processes have been through many technological changes, so much that they then portray with high credibility to their natural competitors. As the image of the artificial approaches the natural, the more it is can be manipulated for purpose of design in the manufacturing process. The image of ‘almost natural’ emerges from an ‘ultra-artificial’ context (Manzini, 1993).

## 5. RESULTS

### 5.1. Naturalness and Preference Rankings

Each interviewee made their own scales of Naturalness and Preference of the 5 material samples presented. Tables 3 and 4 show, respectively, the rankings of Naturalness and Preference by each Interviewee (*En*).

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**Table 2. Naturalness Ranking**

	<b>1 - Most Natural</b>	<b>2 - Natural</b>	<b>3 – Intermediate</b>	<b>4 - Artificial</b>	<b>5 - Most Artificial</b>
E 1	Am 003	Am 001	Am 002	Am 004	Am 005
E 2	Am 002	Am 004	Am 003	Am 005	Am 001
E 3	Am 003	Am 002	Am 001	Am 004	Am 005
E 4	Am 003	Am 001	Am 002	Am 004	Am 005
E 5	Am 002	Am 003	Am 004	Am 005	Am 001
E 6	Am 003	Am 002	Am 004	Am 001	Am 005
E 7	Am 002	Am 003	Am 001	Am 004	Am 005
E 8	Am 003	Am 002	Am 004	Am 001	Am 005
E 9	Am 001	Am 004	Am 002	Am 003	Am 005
E 10	Am 002	Am 001	Am 003	Am 005	Am 004
E 11	Am 001	Am 003	Am 002	Am 005	Am 004
E 12	Am 003	Am 002	Am 001	Am 005	Am 004
E 13	Am 002	Am 003	Am 005	Am 001	Am 004
E 14	Am 001	Am 003	Am 002	Am 004	Am 005
E 15	Am 002	Am 003	Am 001	Am 004	Am 005
E 16	Am 002	Am 005	Am 003	Am 001	Am 004
E 17	Am 003	Am 002	Am 005	Am 001	Am 004
E 18	Am 001	Am 003	Am 002	Am 004	Am 005
E 19	Am 002	Am 003	Am 005	Am 001	Am 004
E 20	Am 001	Am 003	Am 002	Am 004	Am 005
E 21	Am 002	Am 003	Am 001	Am 004	Am 005
E 22	Am 002	Am 003	Am 001	Am 005	Am 004
E 23	Am 003	Am 002	Am 001	Am 005	Am 004
E 24	Am 002	Am 005	Am 003	Am 001	Am 004
E 25	Am 003	Am 002	Am 004	Am 001	Am 005
E 26	Am 005	Am 003	Am 001	Am 002	Am 004
E 27	Am 002	Am 005	Am 003	Am 001	Am 004
E 28	Am 002	Am 003	Am 001	Am 004	Am 005
E 29	Am 002	Am 005	Am 001	Am 004	Am 003
E 30	Am 004	Am 001	Am 002	Am 003	Am 005

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**Table 3. Preference Ranking**

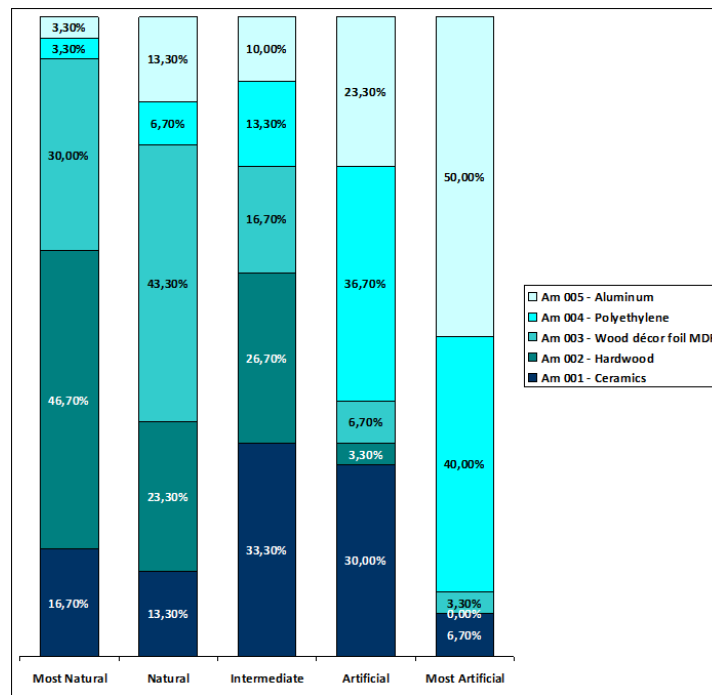
	1 – I like the most	2 – I like it a lot	3 - Indifferent	4 – I like it a little	5 – I like it the least
E 1	Am 003	Am 005	Am 004	Am 002	Am 001
E 2	Am 002	Am 003	Am 005	Am 004	Am 001
E 3	Am 003	Am 002	Am 004	Am 001	Am 005
E 4	Am 002	Am 003	Am 001	Am 004	Am 005
E 5	Am 002	Am 005	Am 003	Am 004	Am 001
E 6	Am 004	Am 002	Am 001	Am 003	Am 005
E 7	Am 004	Am 002	Am 003	Am 005	Am 001
E 8	Am 003	Am 002	Am 004	Am 001	Am 005
E 9	Am 002	Am 004	Am 003	Am 005	Am 001
E 10	Am 002	Am 003	Am 005	Am 004	Am 001
E 11	Am 003	Am 002	Am 001	Am 005	Am 004
E 12	Am 002	Am 004	Am 001	Am 003	Am 005
E 13	Am 001	Am 002	Am 003	Am 004	Am 005
E 14	Am 005	Am 004	Am 001	Am 003	Am 002
E 15	Am 005	Am 004	Am 003	Am 001	Am 002
E 16	Am 005	Am 004	Am 002	Am 003	Am 001
E 17	Am 003	Am 005	Am 002	Am 004	Am 001
E 18	Am 001	Am 002	Am 004	Am 005	Am 003
E 19	Am 003	Am 002	Am 005	Am 004	Am 001
E 20	Am 003	Am 004	Am 002	Am 001	Am 005
E 21	Am 003	Am 005	Am 002	Am 001	Am 004
E 22	Am 001	Am 004	Am 003	Am 002	Am 005
E 23	Am 002	Am 001	Am 004	Am 003	Am 005
E 24	Am 002	Am 003	Am 001	Am 004	Am 005
E 25	Am 003	Am 002	Am 004	Am 005	Am 001
E 26	Am 002	Am 004	Am 005	Am 003	Am 001
E 27	Am 002	Am 004	Am 003	Am 005	Am 001
E 28	Am 002	Am 004	Am 005	Am 001	Am 003
E 29	Am 005	Am 002	Am 004	Am 003	Am 001
E 30	Am 001	Am 004	Am 002	Am 005	Am 003

The answers were analyzed by frequency analysis techniques and are presented on charts below (Figure 6 and Figure 7).

Figure 6 presents the data of Naturalness. The data collected indicates that for the ranking *1 – Most Natural*, the material sample Am 002 – Hardwood presented the highest frequency of answers. As for ranking *2 – Natural*, Am 003 – Wood décor foil MDF was selected for the

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majority of the responses. Sample Am – 003 – Ceramics was selected for the ranking 3 – *Intermediate*. Sample Am 004 – Polyethylene was most indicated as 4 – *Artificial*. Finally, Am 005 – Aluminum was most ranked as 5 – *Most Artificial*.



**Figure 6. Chart of interviewees' naturalness ranking.**

The Naturalness ranking defined by users differs from the Scale of Naturalness proposed as a reference for this work. Hardwood was the only material that featured the same position, being considered the most natural in both Scale of Naturalness, and by interviewees. Hardwood was also highly selected in second place as 2 – *Natural*, which means that if it was not perceived as the most natural, it is still perceived as very natural by users.

Ceramics on the Scale of Naturalness is shown as being natural, however its results showed otherwise upon being evaluated by interviewees. It was indicated as being an intermediate material between natural and artificial.

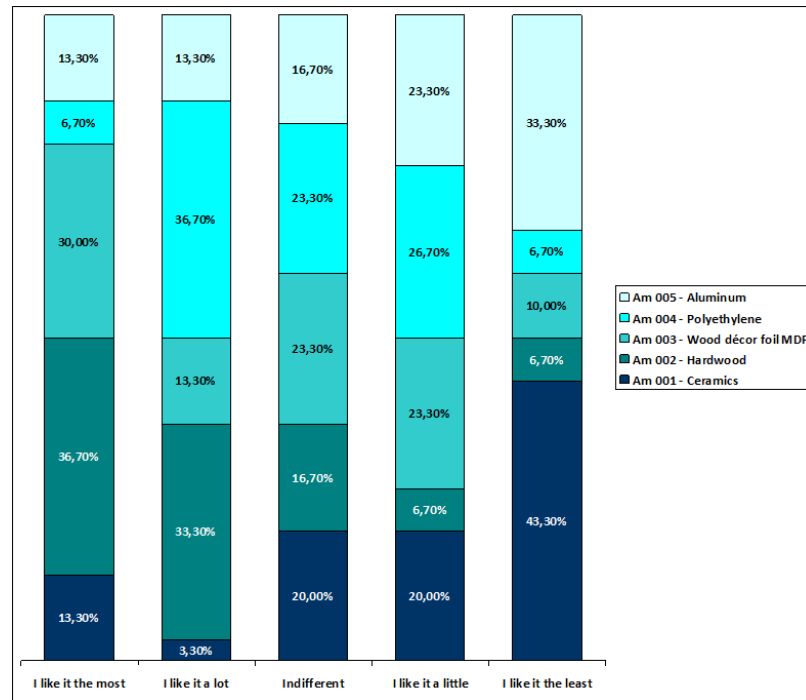
Polyethylene was similarly positioned in both Scale of Naturalness and by interviewees. In both cases it has been considered artificial.

As for Aluminum, it was formerly considered as intermediate in the Scale of Naturalness, but was ranked as the most artificial by users. Its indication of artificialness was even greater than Hardwood's indication of naturalness.



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The rankings of preference are presented on Figure 7. Hardwood and Wood décor MDF showed higher frequencies rates for the first position 1 – *I like it the most*, which indicates users might prefer these materials. Hardwood had 36.7% of indications and MDF 30%.



**Figure 7. Chart of interviewees' preference ranking.**

In second position 2 – *I like it a lot*; polyethylene had higher ranks, with 36.7% indications. The next in line is Hardwood, with 33.3%.

As for position 3 – *Indifferent*, frequencies present little variation. MDF and Polyethylene had equal rates of 23.3%. Aluminum and Hardwood also had equal rates of 16.7%. Ceramics had the highest rate with 20% of the responses.

Just as similarly, the frequency of results for the ranking of number 4 – *I like it a little* were very close, except for material sample Am 002 – Hardwood, with only 6.7% of the answers.

Finally, as for position 5 – *I like it the least*; Ceramics had the highest frequency of 40%. Aluminum follows with 33.3% of the responses.

## 5.2. Product choice

At the second part of the tests, interviewees were instructed to remove the boxes containing the material samples, revealing the 5 prototypes (Pr). The purpose of this part of the tests

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was for the interviewees to assign a use to the products, based on their previous judgments of material samples. For this reason, the products had the same shape and dimensions. The aim was for the interviewees to make their decisions based solely on material, not the objects shape.

The products indicated by interviewees and their choices are listed on Table 4.

**Table 4. Relations between product indication and interviewees' choices**

Product indicated	Material	Choice frequency
Tray	Ceramics	1
	Hardwood	2
	Wood decor MDF	---
	Polyethylene	---
	Aluminum	1
Flooring	Ceramics	1
	Hardwood	4
	Wood decor MDF	---
	Polyethylene	---
	Aluminum	1
Covering pieces (walls, flooring, furniture)	Ceramics	---
	Hardwood	2
	Wood decor MDF	3
	Polyethylene	1
	Aluminum	2
Furniture	Ceramics	1
	Hardwood	6
	Wood decor MDF	3
	Polyethylene	---
	Aluminum	1
Paperweight	Ceramics	---
	Hardwood	---
	Wood decor MDF	---
	Polyethylene	---
	Aluminum	1

Out the 30 interviewees, only 4 indicated the product as being a tray. Only one interviewee indicated it as being a paperweight. All the others indicated the product as being a part of larger pieces, such as wall coverings, flooring modules, or furniture.

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Table 5 presents the frequency and number of times a product was indicated as the interviewers' preference.

**Table 5. Relations between material indication and frequency of choice**

Product – Material	Choice frequency	Percentage
Pr 001 – Ceramics	3	10%
Pr 002 – Hardwood	14	46.67%
Pr 003 – Wood decor MDF	6	20%
Pr 004 – Polyethylene	1	3.33%
Pr 005 – Aluminum	6	20%
Total	30	100%

Hardwood was previously ranked as *The Most Natural* material and continued as the highest ranking for preference. In this stage of the research, it was still nominated as interviewees' material of choice upon product application. Aluminum, formerly given indications of being the most artificial material sample and with a low preference ranking, was said to be the material of choice to the same degree as Wood décor foil MDF, previously indicated as very natural and liked by users.

However, polyethylene, once indicated as being artificial and yet highly ranked in preference by interviewees, was now the least chosen material upon being applied to product, with only one time being chosen. It is worth mentioning that the interviewee who selected it as their product of choice was the same who had previously considered it their favorite sample.

Results show that naturalness is perceived through the sensory aspects of vision and touch. Wood and its imitations are perceived as the most natural and are interviewees' preferred material choice, although product choice is not necessarily influenced by material naturalness, but rather material use function.

## 6. DISCUSSIONS

According to some interviewees, there was a slight confusion when samples were presented in the boxes during the first stage of research. Some of them believed that polyethylene was, in fact, lacquer glass. The piece itself was initially supposed to be plain white, but it was coated with metallic paint so that it had closer similarity to industrial plastics and a smoother surface.

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The pieces were designed taking into consideration: a) project deadline and schedule; b) financial resources available; and c) available manpower for the implementation of the pieces.

It was interesting to observe the associations interviewees made when considering product usage. The fact that interviewees had not been informed of the function of the products was important because their associations of the product usage and preferred product was based solely on the material used. It was found that, in fact, the naturalness of the material was an aspect that influences preference but is not necessarily the deciding factor when choosing a product.

The research context may have been swayed by factors of influences, since all interviewees were aware of the project being a part of a Master Built Environment and Sustainable Heritage at UFMG. This may have influenced the way that most described the products as floor modules, parts of furniture and wall coverings.

Although the scale used was adequate for this study, it is a sample subject to be further studied. In this study, it has been used in this work as a reference for users' perceptions during the data collection. The criterion used was of observing materials and noting their main production uses, but more detailed issues were not explored such as the molecular constitution of the materials. Also, there was not a comparative study made between the various forms of processing materials, specifically between the industrial and handcrafted products. Taking this into consideration, there are new ways to approach the potential for enhancing the scale.

## 7. CONCLUSION

From the research, it was noted that users consider wood and its impersonations the most natural materials. The solid wood is considered to be the most natural and there were no significant indications of its artificiality. Even the MDF coated with laminated BP timbered-standard, considered as the most artificial material on the Scale of Naturalness, was selected by the interviewees as a natural material. That is, even being a material that goes through various industrial processes, standard wood flooring brings a sense of naturalness.

Metal and plastic are considered artificial materials by users. Their classification due to the origin of these materials showed that interviewees considered metals and plastics artificial or very artificial and the results were more homogeneous than those for naturalness of the wood and the coated MDF.

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In this sense, the study showed that users' perception of a materials naturalness is not based on the technical aspects of production, but rather the physical attributes of the material such as its texture, color, sensation of touch, designs on the surface etc.

With regard to the preferences of the interviewees, wood and its imitations were the most highly expressed among the study's findings, suggesting that people tend to prefer this material. Both solid wood and MDF coated materials had high levels of favorability.

However, plastics, which was considered an artificial material, was still a material of preference amidst interviewers. The same results did not occur in the case of aluminum, which was regarded as very artificial material and yet continued with low rankings in the category of preference. This leads to the conclusion that users tend to have a preference toward wood, but not necessarily because of its naturalness.

With respect to application of the material to the product, the user still showed a tendency to prefer the solid wood. The test indicated 46.67% of respondents choose wood as their preferred material for application in coatings and furniture parts.

However, the coated MDF, considered as a natural material, had the same rates of acceptance that aluminum did when applied to the product. Aluminum had been indicated as the most artificial material and had low levels of preference. However, applied to the product, was not viewed any differently than the MDF material.

Polyethylene, which had been ranked as artificial and presented a high degree of favorability, was the material chosen the least by users, when applied to the product. As indicated in the results, although the material was highly favored, the users did not choose it for application in coatings or furniture. So, it can be said that the material applied to the product depends on other aspects that go beyond user's preference. The choosing of a product depends on other factors more than just the degree of naturalness and preference, but also on a larger context, which includes other functional aspects and personal perspective, feelings, beliefs, and desires.

The use of the product also influences on the material of choice. As indicated by interviewees, a product is more or less adequate to a specific use, and the material applied to it will also determine its adequacy. Hardwood, for instance, seemed to be more adequate to flooring and furniture, whereas plastics and metal didn't present the same results as indicated by interviewees. That allows us to conclude that the final use of the product will determine the choice of the material.

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