



# I can't believe this isn't wood! An investigation in the perception of naturalness

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## ABSTRACT

For most people “naturalness” is a highly appreciated material characteristic. For instance, a natural wooden floor is seen as more valuable than a fake replica, though they may be comparable in quality and durability. In the present study we investigated how sensory input (vision and touch) contributes to the perception of naturalness in wood. Participants rated samples of wood or imitations thereof, such as vinyl and veneers. We first attempted to provide a validation of the measurement of perceived naturalness by comparing four psychophysical measurement methods (labelled scaling, magnitude estimation, binary decision, and ranked ordering). Second, we investigated the contribution of vision and touch by measuring the perception of naturalness in three exploration modalities (vision only, touch only, and visuo-tactile). The results show a high degree of consistency across measurement methods, suggesting that we measured a common underlying construct that relates to naturalness. It also suggests that this construct is represented on a metathetic (categorical) continuum. Moreover, we found that both vision and touch are highly correlated predictors of visuo-tactile perception of naturalness.

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## 1. Introduction

Most humans show a preference for natural materials over artificial or synthetic replicas. Although some exceptions can surely be found, in general, objects manufactured with natural materials are perceived to be qualitatively better than objects made of synthetic materials. The human preference for natural has been empirically demonstrated for food and medicines (Rozin et al., 2004) and also for landscapes (Purcell & Lamb, 1998), a preference which holds across cultures (Kaplan & Herbert, 1987). This preference for natural things possibly underlies and strongly influences the outcome of decisions made in many everyday contexts, i.e. when choosing what to eat or selecting what objects to use or buy. It is therefore remarkable that barely any research has addressed the sensory factors that may determine the perception of naturalness. In fact, the existence of naturalness as a perceptual attribute has been seldom considered. In this study, we attempt to substantiate the concept of naturalness as a perceptual variable and to address the contribution of vision and touch to the perceived naturalness of materials.

Although almost no research has been conducted on the perception of naturalness in materials, some has been done in the domain of foods, pioneered by Rozin and colleagues. According to his

work, the perception of naturalness of a particular substance depends on the knowledge about the history of transformations that it has undergone from its original state: contagion, chemical changes, processing and mixing (Rozin, 2005, 2006). In Rozin's studies, participants had to rate the degree of naturalness of a variety of substances, mostly foodstuffs, from verbal descriptions. Amongst other things, Rozin found that a small amount of an additive that has some negative or non-natural characteristic produced a large drop in perceived naturalness of the substance, even when this additive was later taken out from the product. An interesting aspect of (Rozin et al.'s, 2004; Rozin, 2005, 2006) findings is that the preference for natural goes beyond the known objective qualities of the substances. That is, despite the physical properties of two substances being exactly the same, people still prefer the one that is subjectively judged as being more natural, on the basis of knowledge about the process in which these substances had been produced. For example, untouched natural spring water would be preferred over physically identical water in which (participants are told that) a certain mineral was removed and re-introduced at a later stage (Rozin, 2005).<sup>1</sup>

<sup>1</sup> Although not all natural things are alive, they are by definition, derived from nature. In this sense, the preference for natural versus artificial things, according to some authors, may be related to an intrinsic and emotional preference which has been named *Biophilia*: “the innately emotional affiliation of human beings to other living organisms” (Frumkin, 2001; Wilson, 1984).

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A possible limitation of (Rozin et al.'s, unpublished manuscript; Rozin, 2005, 2006) work is that sensory input was explicitly excluded, as participants judged naturalness based on written descriptions and could not physically explore the actual substances. Therefore, their results and conclusions are solely based on an observer's prior knowledge provided by the descriptions. However, in everyday life, objective knowledge about the processes that a certain product has undergone is often unavailable and can only be estimated from the sensory information extracted on the spot. In the present study, we focus on the contributions of sensory input on the perception of naturalness; that is, how naturalness is assessed by information gathered by the different senses, specifically vision and touch.

The perception of naturalness, like perceptual representations in general, is likely to be determined by input from different sensory modalities, which may provide complementary aspects of material or object properties. One could think of several different tactile characteristics, which could be critical for the perception of naturalness, for example thermal properties (e.g. Ho & Jones, 2006) or softness (e.g. Srinivasan & LaMotte, 1995). Colour or gloss could be important visual characteristics. Yet some other characteristics are available to more than one sensory modality. For example, roughness and texture (the feel, appearance, or consistency of a surface, substance, or fabric; Oxford Online Dictionary, 2008) are very rich sources of information and are perceived through more than one modality (Bergmann Tiest & Kappers, 2007; Soto-Faraco & Deco, 2009; Whitaker, Simoes-Franklin, & Newell, 2008). In these cases, the representation of these attributes most likely arises from the integration of input from different senses (e.g., Ernst & Bulthoff, 2004).

### 1.1. Scope of the present study

The aim of the current study is to unravel the importance of sensory input in different modalities for the perception of naturalness, as opposed to the influence of a priori knowledge about the history of the object as studied in the past by (Rozin, 2005, 2006; Rozin et al., 2004). Moreover, a complementary objective of this study is to provide grounding to the concept of naturalness as a measurable perceptual feature. Although the concept of naturalness is widely used, for example to qualify a material, and it seems to have a straightforward meaning in our everyday conversations, a clear objective definition is lacking. This lack of definition makes naturalness hard to address but it should not prevent its investigation altogether, in analogy to other ill-defined psychological constructs like consciousness (e.g., Crick & Koch, 2003) and attention (e.g., Pashler, 1994). For practical purposes we developed an operational definition of "natural" as something that is "derived from nature". This definition is derived from the Oxford dictionary entry, and adjusted to serve the purpose of this study.

Since the physical properties that are relevant to naturalness are in principle unknown, it is not possible to describe the relationship between physical parameters of the stimuli and their subjective correlate, perceived naturalness, as it would be done in the classical psychophysical approach (Gescheider, 1997). However, the attempt to use psychophysical methods to address ill-defined psychological constructs, such as the aesthetics of abstract forms (Fechner, 1876) or the seriousness of a criminal offence (Thurstone, 1927) is almost as old as modern psychophysics itself. In order to measure this type of properties, one must agree on the type of psychological scale emerging from the data, and it is generally accepted that a powerful type of validation is to show consistency of the measured property across different measurement methods. Moreover, the type of relation between the results of different measurement methods informs us on the type of data we are measuring. If the relation is linear, the data are represented on a metathetic continuum (qualitative; categorical).

However, if the relation is nonlinear the data are represented on a prothetic continuum (quantitative; how much) (Gescheider, 1997, Chapter 14). In the present study, we evaluated the measurability of naturalness by using four different methods: labelled scaling, binary decision, free-modulus magnitude estimation and ranked ordering (see Method section for a description of each).

Another point of consideration is that the sensory correlates of naturalness might in principle vary quite a lot from one category of materials to another (e.g. wood vs. stone vs. fabric). This problem of variation, which is possibly related to the multidimensional nature of the concept of naturalness (and the difficulties in defining it), makes it important to study each category of objects individually. Although outside of the scope of this study, we should expect variations in the degree in which different sensory properties contribute to the perception of naturalness across different materials. For introducing the study of the perception of naturalness of materials, and as a proof of principle, in the current study we decided to focus on the perception of naturalness in wood and artificial replicas thereof. We chose wood since this is a material that most people are familiar with and it comes in various forms and imitations.

The first goal of the current study is to obtain a validation of perceived naturalness measurements by cross-correlating four different methods. The second goal is to address the multisensory contributions to the perception of naturalness by evaluating the observer's performance through vision and touch separately and in combination.

## 2. Experiment 1

### 2.1. Method

#### 2.1.1. Participants

Thirty-two participants (24 females; 29 right-handed; mean age 23.6, range 17–37) took part in this study. Sixteen of them participated in both labelled scaling and magnitude estimation, and the other 16 participated in the binary decision task and the ranked ordering task. All participants had normal or corrected to normal vision, normal touch, and had no professional expertise concerning wood or imitation wood.

#### 2.1.2. Wood samples

Thirty different pieces of wood (14) and imitations thereof (16) were selected for this experiment. The samples were either made of real oak, varying in the treatments they underwent, or imitations of oak, varying in the materials they were made of (see Table 1 for a short description of each sample, and Table A1 for several physical measurements on these samples). We classified a sample as natural when the largest part of the sample consisted of real wood. When the sample consisted of only a small proportion of real wood (like the veneers) we categorized them as artificial. However, this classification is relatively unimportant, because our analysis is based on the probability of a sample being classified as natural across measurement methods and modalities.

The samples were mounted in 12 by 12 by 5.5 cm grey plastic boxes, so that only the top surface of the sample could be explored through a window of 8 by 8 cm. When presented to the observer, the samples were all shown with the grain aligned with viewing direction (vertically; see the inset in Fig. 1).

#### 2.1.3. Design and procedure

The participants sat behind a table in front of an 80×80×80 cm photographic daylight tent, which was illuminated by six 50 W white daylight 5000 K light bulbs. In this way the samples were illuminated under constant lighting conditions with scattered light, which is important since the direction of the light can influence the perception of certain features of wood (Brown,

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