Measuring Perception of Naturalness

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Measuring Naturalness

Naturalness is often regarded as a highly valued property of a material. Most of us, for example, would accept to pay more for a natural silk dress or wooden floor than for functionally equivalent but "fake" versions, meeting the same standards. What physical properties are underlying naturalness perception? And how do people know the difference? The MONAT (Measurement of Naturalness) project aims to understand how the perception of naturalness is formed.

Each material has specific physical properties that differentiate them from other materials. These properties are picked up by one or several of our sensory systems and bound into a unitary percept. For example, properties like colour and glossiness are perceived by our visual system, whereas temperature and roughness are encoded by the tactile system. At some stage of processing these, initially separate, perceptual properties are combined to form a unitary percept of the material upon which any judgments about its naturalness will be based.

Using a multidisciplinary approach, we seek to better understand the relationship between the physical measurements of material properties and the perceptual as well as neural bases of naturalness judgements by humans. In this paper we will focus on the subjective measurements of human naturalness judgements, and the contributions of vision and haptics to this perceptual decision.

Psychophysical Measurements of Naturalness

Psychophysics is a sub-discipline of psychological measurements which aims to unravel the relationship between objective characteristics of physical stimuli and their subjective interpretation by a human observer. A common problem in psychophysics is establishing a link between the (subjective) perception being measured and the (objective) physical parameters being manipulated. Because naturalness is, in itself, a rather elusive concept, psychophysical measurement is extremely difficult. To tackle similar problems in the past, researchers have made use of converging measures from different psychophysical paradigms. The rationale is that if several measuring methods provide consistent subjective estimates, one can conclude that they are measuring the same perceptual property, and that such a property has a psychological status. Here, we used an approach based on direct measurements of naturalness: labelled category scaling, free modulus magnitude estimation and a two- alternative forced choice (2AFC) task. In this paper we investigate whether these three ways of measuring naturalness judgments are actually measuring the same underlying property (i.e., naturalness), and what the contributions of vision and haptics are to the perception of this property.

In all three methods we used the same experimental setup. Participants were seated behind a table in such a way that the angle between the thorax and the table was approximately 90°. The height of the chair was adjusted so that they could comfortably reach the stimuli. The stimuli were 30 different samples of real wood, laminate, veneer, vinyl and photocopy, all being oak or imitations thereof. They were mounted behind a window of 8 by 8 cm in the top of a square, gray plastic box, so that the participant was only able to see and/or feel the top surface of the material sample. The samples were placed one by one in a standard daylight tent for 3 seconds. In the visual exploration conditions, the participant was only allowed to look at the stimuli. In the tactile exploration condition a curtain was placed between the participant and the stimulus to prevent them from seeing the sample. In this condition, they were asked to perform 3 one-second circular movements with the index finger of their dominant hand on the surface of the stimulus. In the visuo-tactile exploration condition the participant was asked to use both these exploration strategies simultaneously. In all cases, after three seconds exploration time, observers had to verbally state their judgement (see measurement methods, below). The measurement methods were counter-balanced and the stimuli were presented in random order for each observer and condition.

Labelled Category Scaling

In labelled category scaling the participant is required to label each stimulus according to a pre-defined scale with labelled categories. Rozin [1] investigated the perception of naturalness in the domain of foods using a labelled category scale, so we decided to use a Spanish version of his scale. In table 1 we show the original (English) version.

Table 1. *Labbeled scale of judgement of naturalness used in the experiment (the English original [1])*

0	Not natural at all
1	Very slightly natural
2	Slightly natural
3	Moderately natural
4	Very natural
5	Extremely natural
6	Completely natural

Free Modulus Magnitude Estimation

Free-modulus magnitude estimation is based on the magnitude estimation method as described by Stevens [2]. Participants were asked to assign any (arbitrary) numerical value to the first stimulus, and then assign numbers to the following stimuli accordingly, trying to capture the ordering and subjective distance between stimuli for the judged property (naturalness, in this case). They were allowed to use any number they liked. Unlike in the labelled category scaling, we explicitly asked the participant to compare the different stimuli to each other. The numerical scores the participants had given were re-scaled linearly (between 0 – 6) in order to

make this measurements readily comparable between participants and to the other methods.

Binary Decision Task

In the binary decision task, the participants were asked to judge whether they think a stimulus is natural or not. They simply responded with a "yes" or a "no". We averaged the decisions of all the participants and rescaled the results (from 0 to 6) to make the scores comparable to the other methods.

Results and Discussion

The initial results indicate that the measurements are highly correlated, thus suggesting that they measure a common underlying construct. Further analysis and experiments might be needed to investigate whether the concept that we are measuring was actually "naturalness" and not for example one of the characteristics of the wood (e.g. roughness). We will therefore link the measured physical characteristics to the three methods of psychological judgements. Moreover, we will measure naturalness in other materials using the same methods.

Another important finding from the present study is that the visual and haptic estimates of naturalness are moderately correlated, suggesting that their contributions are relatively independent. The combination of visual and haptic estimates, when both are available, seems to amount to a weighted average of the two individual estimates.

References

1. Rozin, P.(2005). The Meaning of "Natural" Process More Important Than Content.*Psychological Science*. **16(8)**, 652-658.
2. Stevens, S.S. (1975). Psychophysics: Introduction to its Perceptual, Neural and Social Prospects, ed. G. Stevens. New York: Wiley