RELATIONS BETWEEN MATERIAL CLASSES AND MATERIAL ATTRIBUTES

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INTRODUCTION

Humans can visually differentiate between and within material classes, such as metal, skin, etc. This affords successful interaction with the environment. This ability to visually differentiate seems to be driven by our ability to perceptually judge attributes, such as glossiness, hardness, etc.

Interestingly, while the appearances of real materials are limited by the rules of chemistry and physics, materials as depicted in paintings have no such constraints (Cavanagh, 2005): incongruencies between paintings and reality often go unnoticed. These 'alternative physics' in art could lead to new insights for perception scientists, since they shed light on image triggers for perceptions.

In this study we first collected materials depicted in paintings and then collected perceptual judgements for each stimuli.

STIMULI COLLECTION

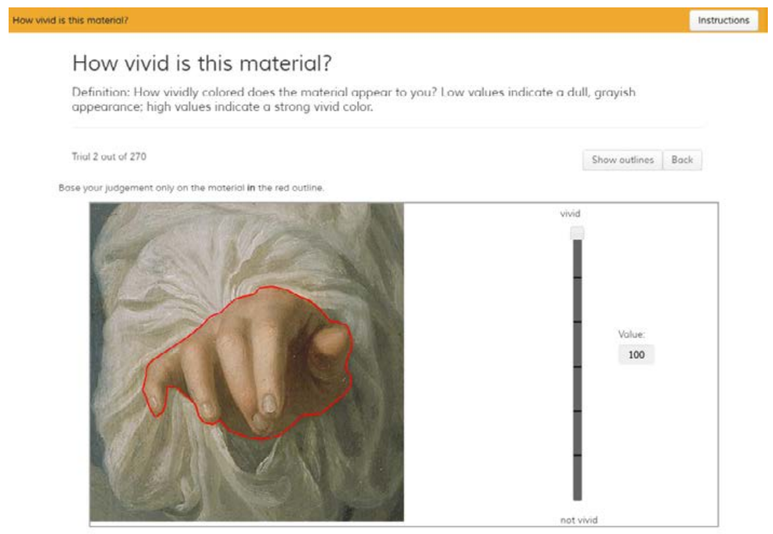
First, we collected paintings.

Then, using human annotators via Amazon Mechanical Turk (AMT) we made 30 segments for each of 15 materials.

- Materials: Fabrics, Ceramic, Metal, Glass, Skin, Liquid, Sky, Paper, Animal, Ground, Gem, Wood, Flora, Stone, Food
- Attributes: Multicolored, Glossy, Hairy, Transparent / Translucent, Rough, Hard, Bendable, Fragile, Cold, Vivid

EXPERIMENT

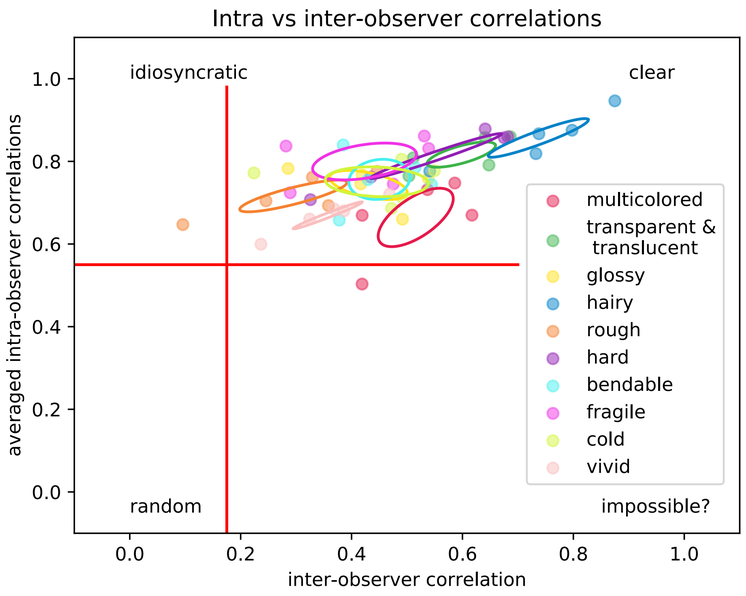
AMT participants would see one set of 90 segments, in which each material was represented equally. They would judge each stimuli on a rating scale for on one of the attributes



RESULTS

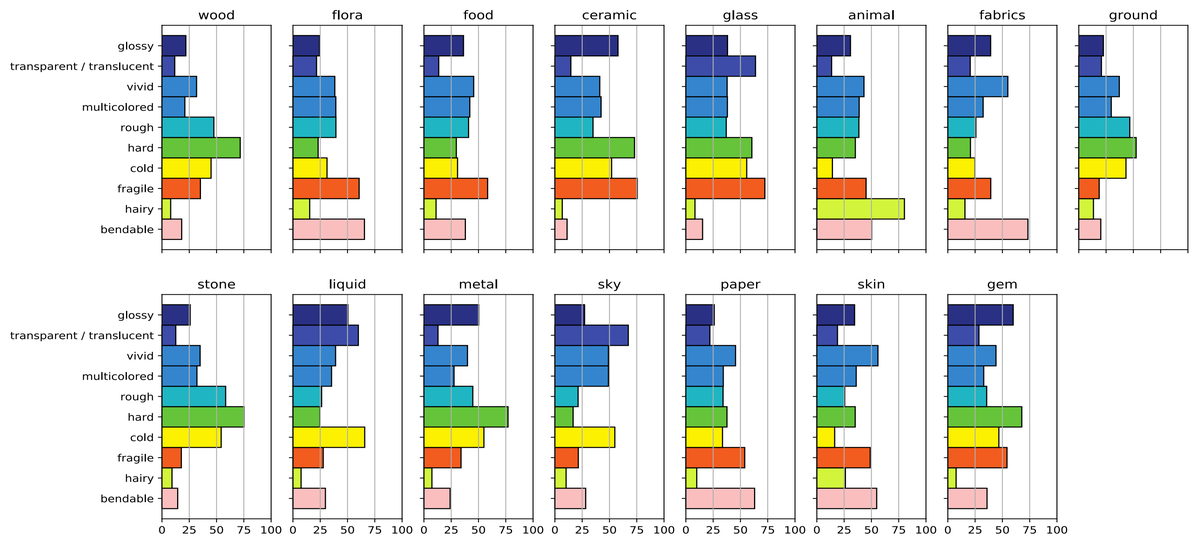
Do observers agree within and between?

High consistency displayed within participants indicates that participants have a clear perception, but consistency between participants depends on the perceptual attribute being rated .



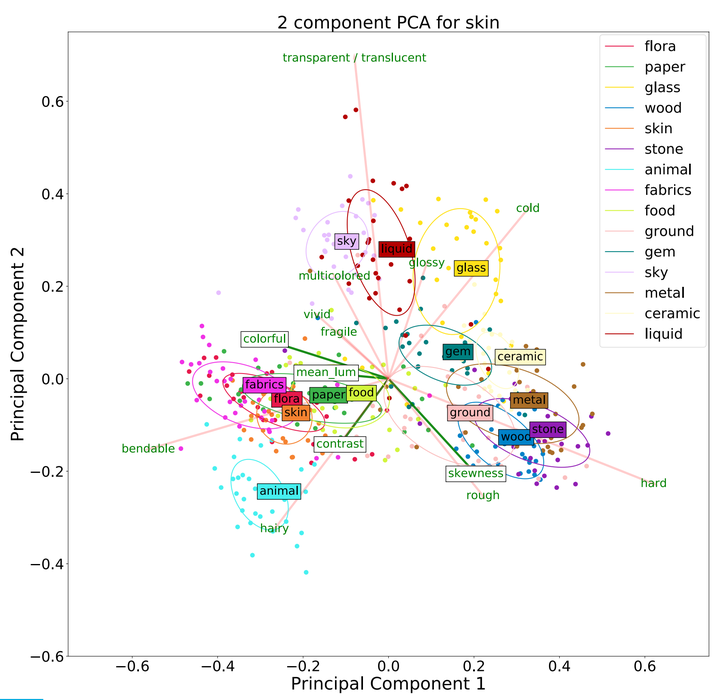
Material property distributions

The distributions are distinct between materials and show variation between materials, yet some materials only differ on one or two attributes.



Principal component analysis

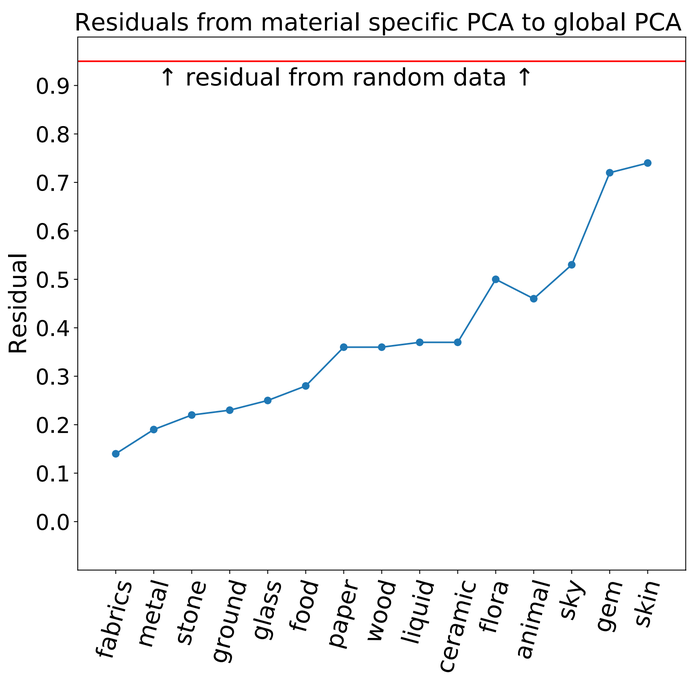
Principal component analysis on the attribute judgements shows that points belonging to the same material cluster together. Furthermore, the space shows a large similarity with the PCA space bound by Fleming et al. (2013) and Zhang & Pont (2019) for photographed and rendered materials respectively. This implies that material perception works independently of the medium of depiction.



How well does the global PCA space describe intra-material variations?

Next, we applied a Procrustes analysis to map each point from a PCA run on the 30 datapoints from one material onto the corresponding points within the global PCA space.

The magnitude of variability differences is material depended, but inter-material variations are explained relatively well by intra-material variations.



CONCLUSIONS

- Material property idiosyncrasies are material dependent, at least as perceived in paintings.
- The similarities found between photographed and painted materials shows that material perception is independent of the medium of depiction.
- Global PCA space describes intra-category variations relatively well, but not equally well for all materials.

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