Exploration of Core Material Appearance Features

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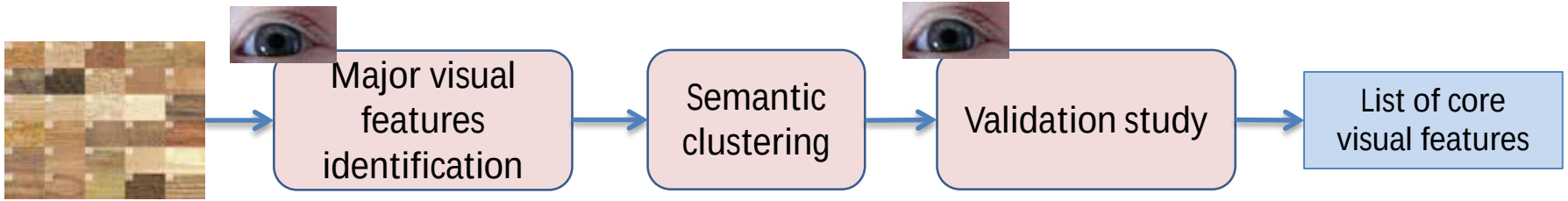
Motivation

- Czech Science Foundation Project 22-17529S:
  - ***Visual Fingerprint of Material Appearance***
- Understanding visual properties of materials from human vision perspective
- Automatically interpreting the visual properties of materials



Psychophysical Study

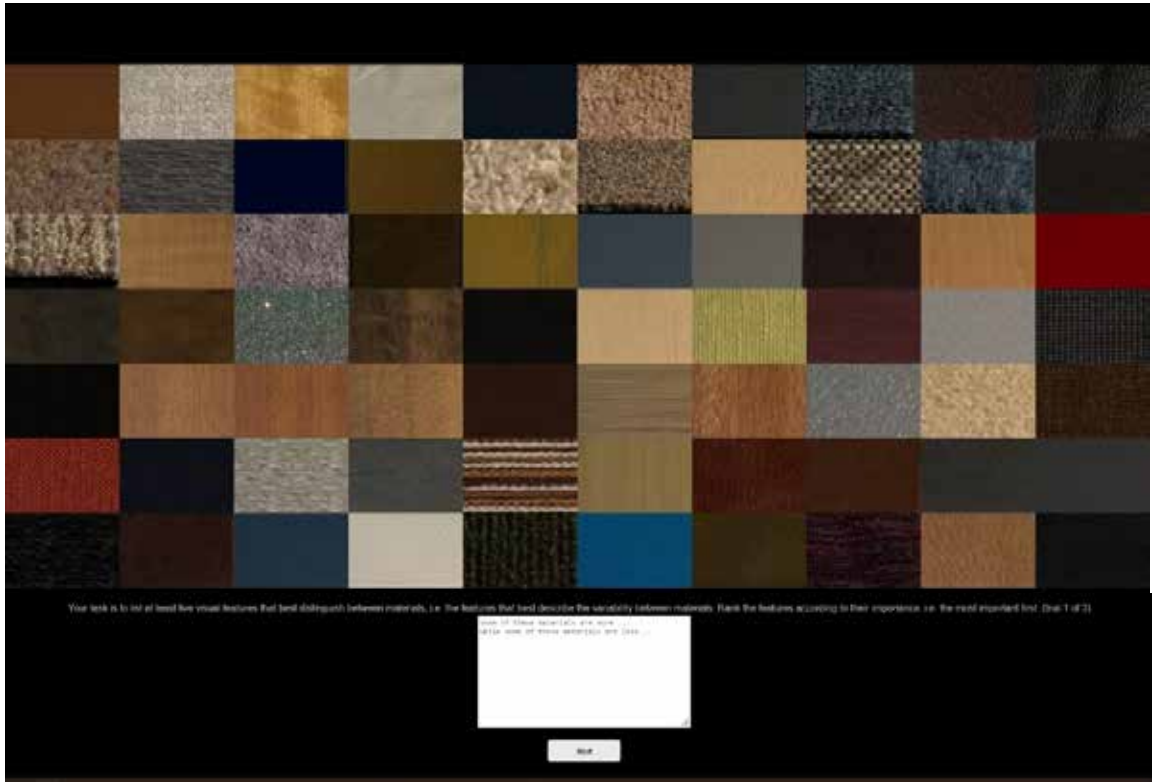
- Goal of the study: identify the most crucial appearance attributes of real materials
- 210 materials including: fabric, leather, wood, plastic, metal, paper
- For each material, we recorded a video showcasing specular and non-specular appearances
- Materials were shown in three separate movies 70 materials each
- Participants were then asked
  - Identify and rank at least five most visually distinguishing features that set apart the materials within each video – the features that make materials different

Psychophysical Study

- 7 categories – fabric, carpet, wood, leather, metal, plastic, coating
- 32 observers
- 452 responses
- mean stimuli duration 2.8 minutes

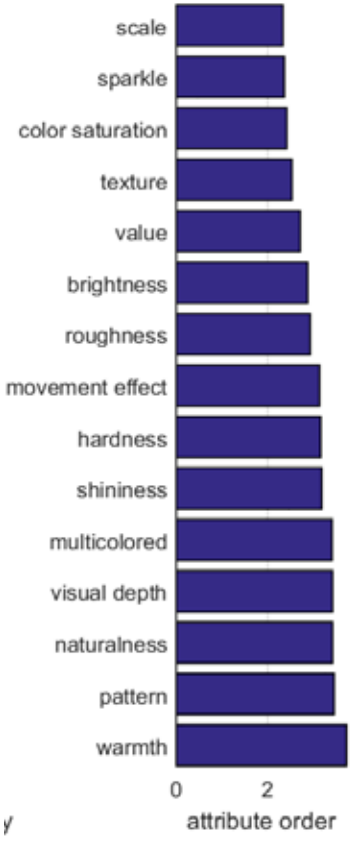
Example answer:

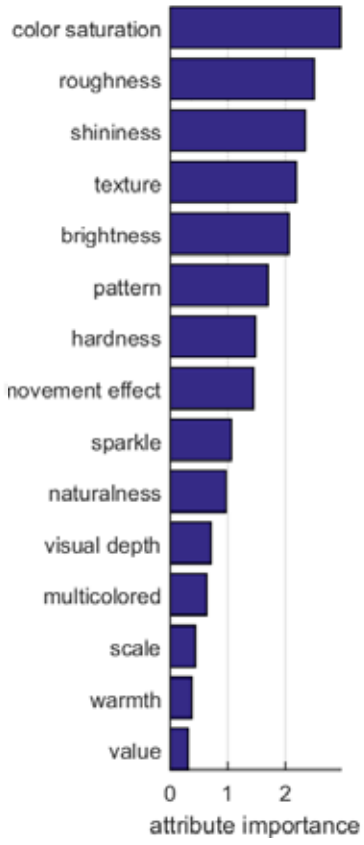
*Some of these materials **shimmer** or **glitter** in the **light***
*Some of these materials **barely catch the light** at all.*
*Some of these materials only look **textured** in specific **lighting**.*
*Some of these materials are more **fibrous** than the others.*
*Some of these materials look **harder** than the others.*
*Some of these materials look **cheaper** than the others.*



Psychophysical Study

- We collected 451 valid text responses from 32 participants
- manual semantic clustering - keywords occurrence
- 15 most frequently mentioned attributes



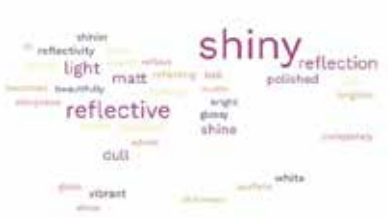


Psychophysical Study

1. Color saturation

2. Roughness

3. Shininess



4. Texture

5. Brightness

6. Pattern

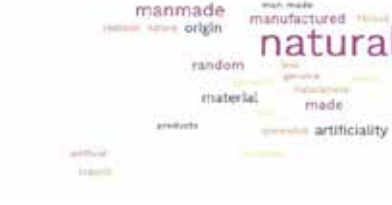
7. Soft/Hard

8. Category

9. Movement effect

10. Sparkle

11. Naturalness



12. Thickness

Validation Study

- 6 participants tasked with clustering all 451 responses to 15 predefined attributes
- The interrater agreement was high – Fleiss' Kappa score of 0.786
- **All six raters** reached a consensus in **43.9% cases** (198 /451)
- **Three raters** agreed in **56.3% cases** (254/451)
- **Two raters** agreed in **87.8% cases** (396/451)
- 16 out 32 participants had their responses completely integrated within the rating system, while the remaining 16 participants exhibited a range of 5.6% - 26.7% divergence.

Conclusions

- 15 the most prominent attributes include common visual features as color variability, saturation, roughness, brightness, shininess, texture, and pattern
- Participants frequently mentioned tactile and subjective attributes like warmth, hardness, naturalness, and attractiveness