

On the communication of material appearance

Jean-Baptiste Thomas

jib.thomas@gmail.com
jean.b.thomas@ntnu.no

NTNU (Détachement 2016-2019)

The Norwegian Colour and Visual Computing Laboratory

<https://www.ntnu.edu/colourlab>

Université de Bourgogne, Franche-Comté since 2010

LE2I // ImVIA

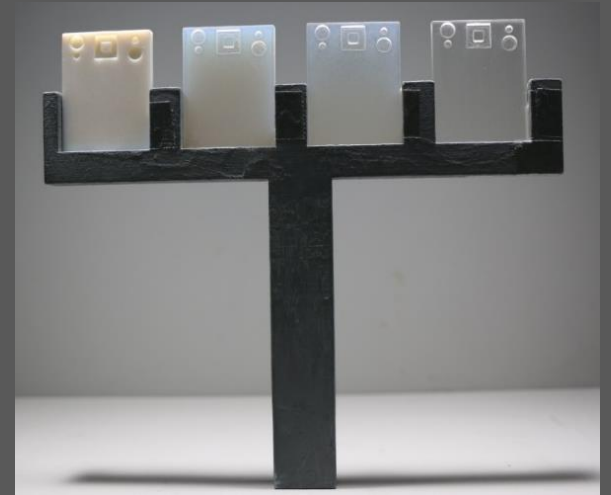
<http://le2i.cnrs.fr/>





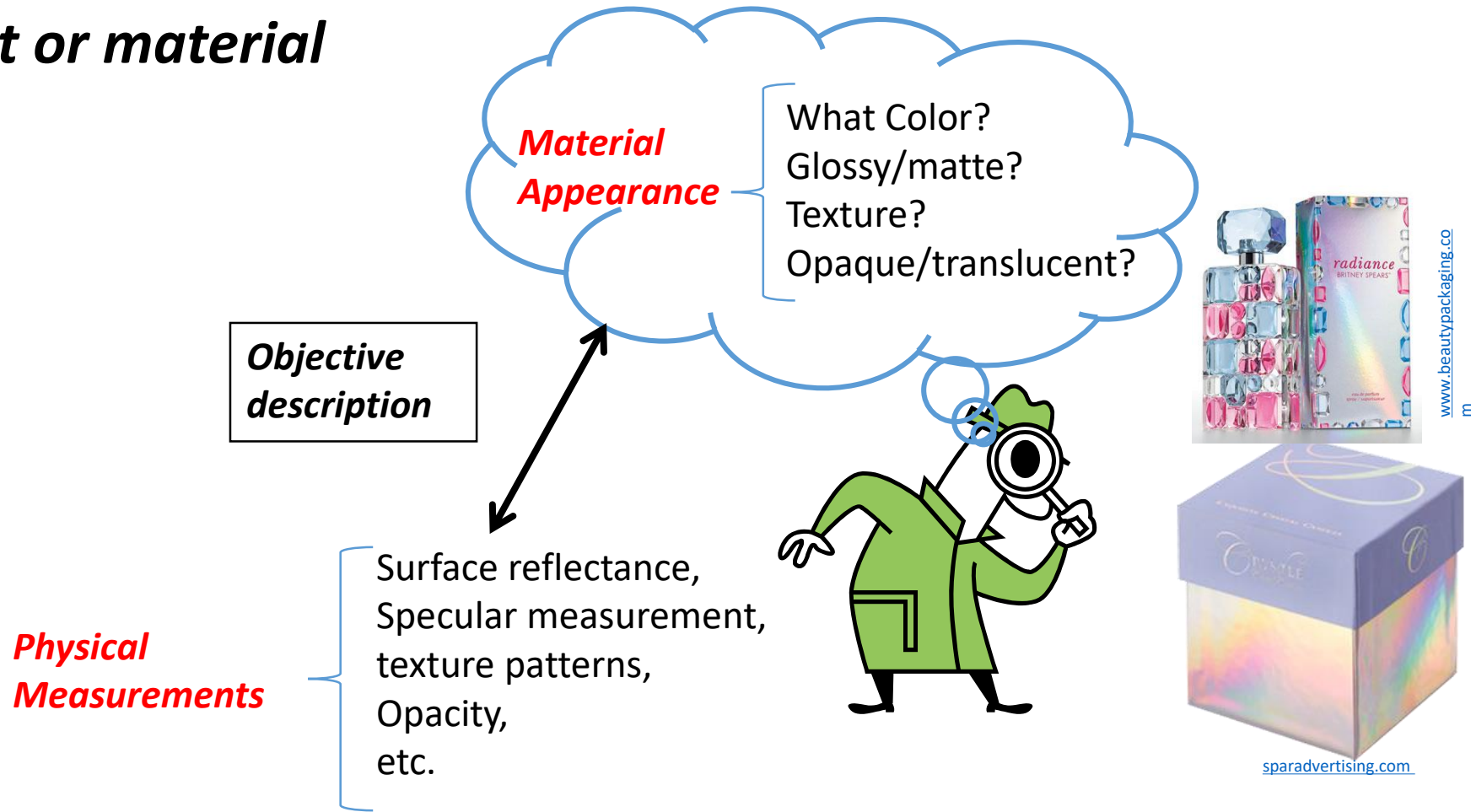
*Cattura di Cristo, Caravaggio
1602, oil on canvas*





Bui Minh Vu, Tejas Madan Tanksale, Philipp Urban and Shigeki Nakauchi, **Visual perception of 3D printed translucent objects**, *24th Color and Imaging Conference*, pp. 94-99, San Diego, USA (2016)

Appearance of an object or material



Situation!

Generative
Cues

Generate
Perception

Social
interaction!

Interaction
Light-material

Radiance

Integration
Acquisition

Sensation
Interpretation
Reaction

Communication

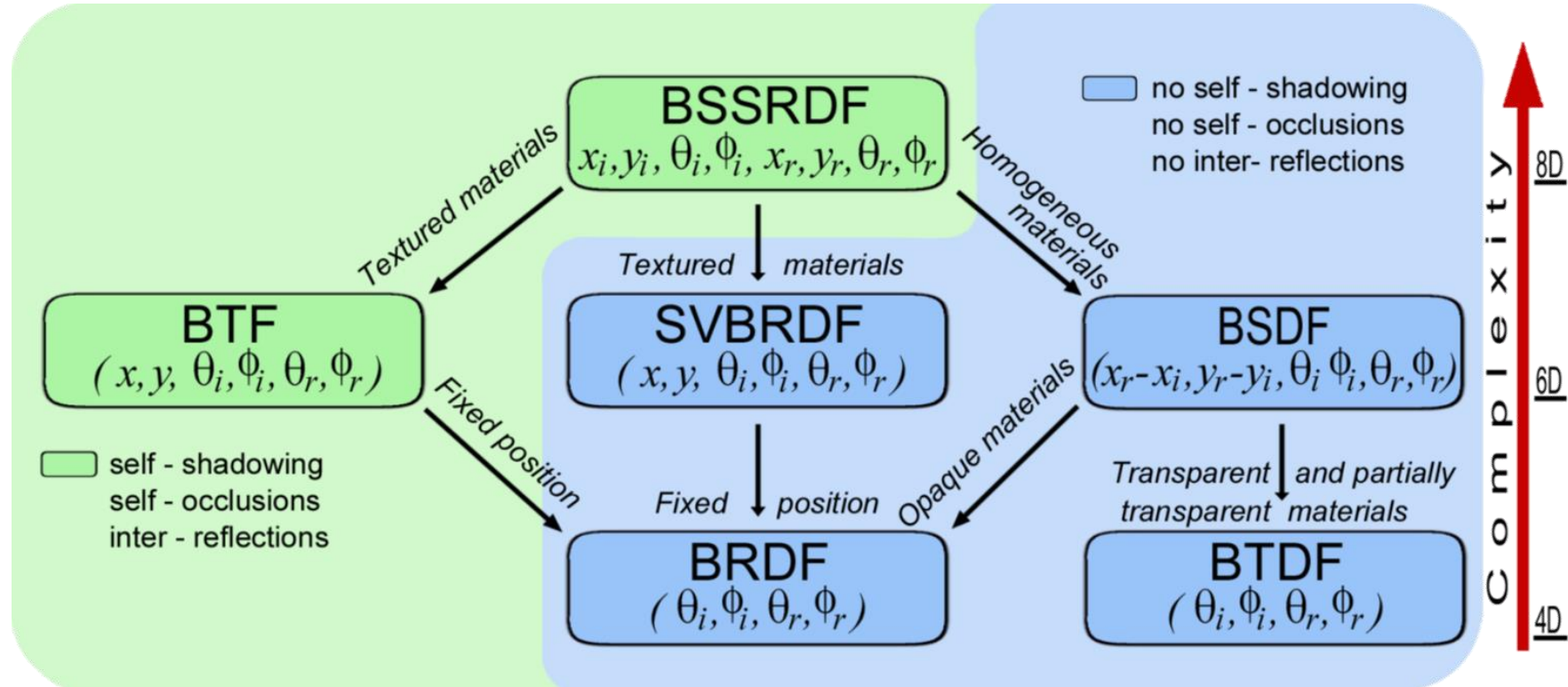
Physics,
Computer-
Graphics

Instrumentation

Soft-metrology

Cognitive
psychology
Models of
appearance

Physics and computer graphics

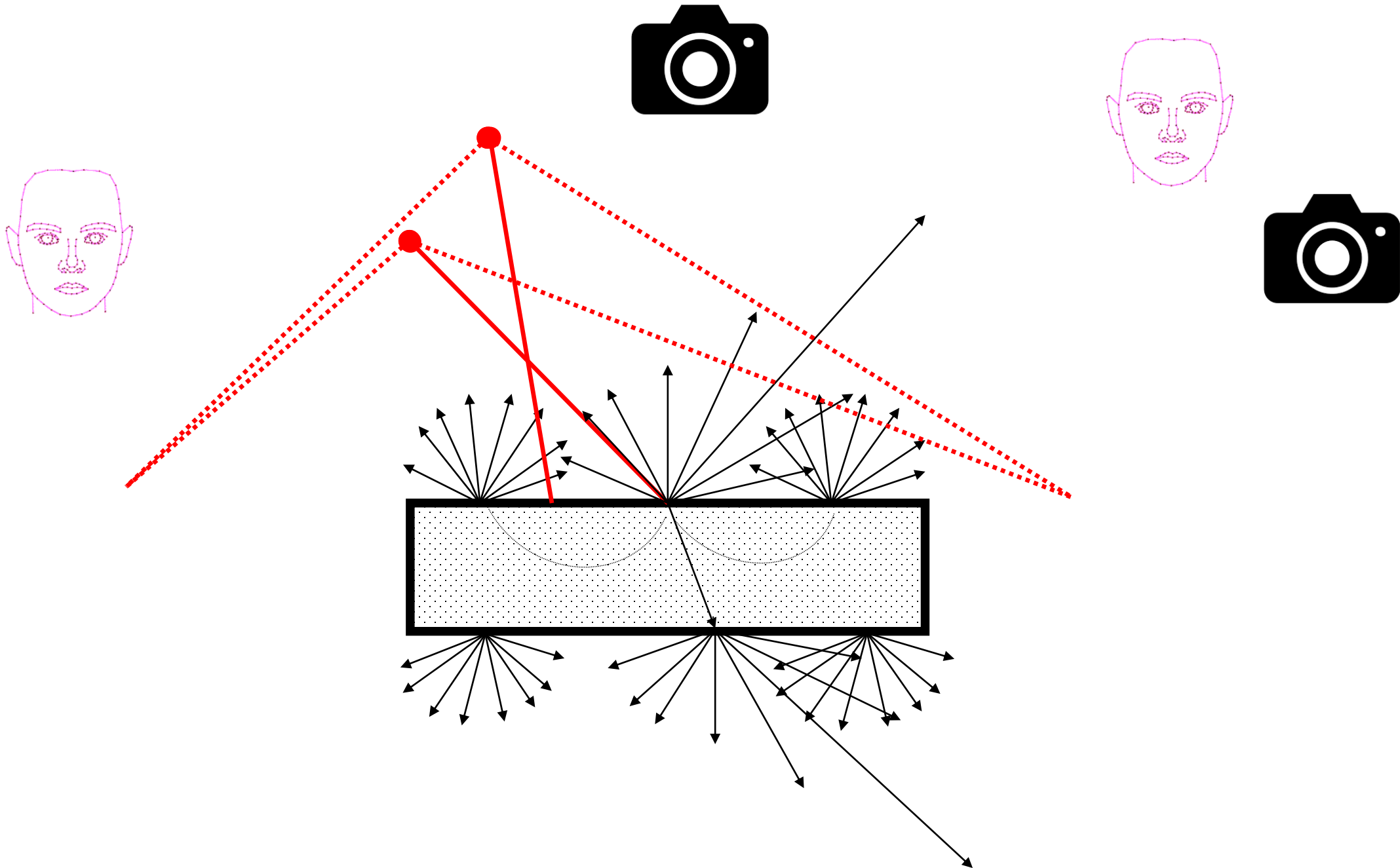


Mostly no inverse model

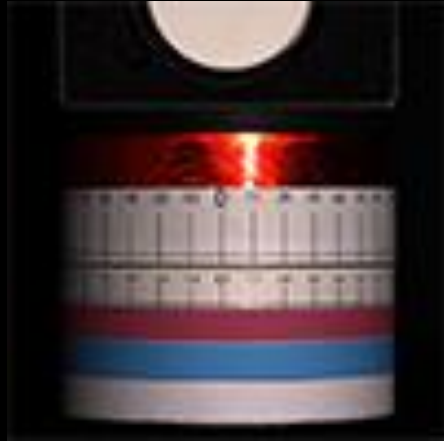
Many data and complexity

Difficult to measure and to model

Relation with perception?



BxxxDF from radiance/calibrated images

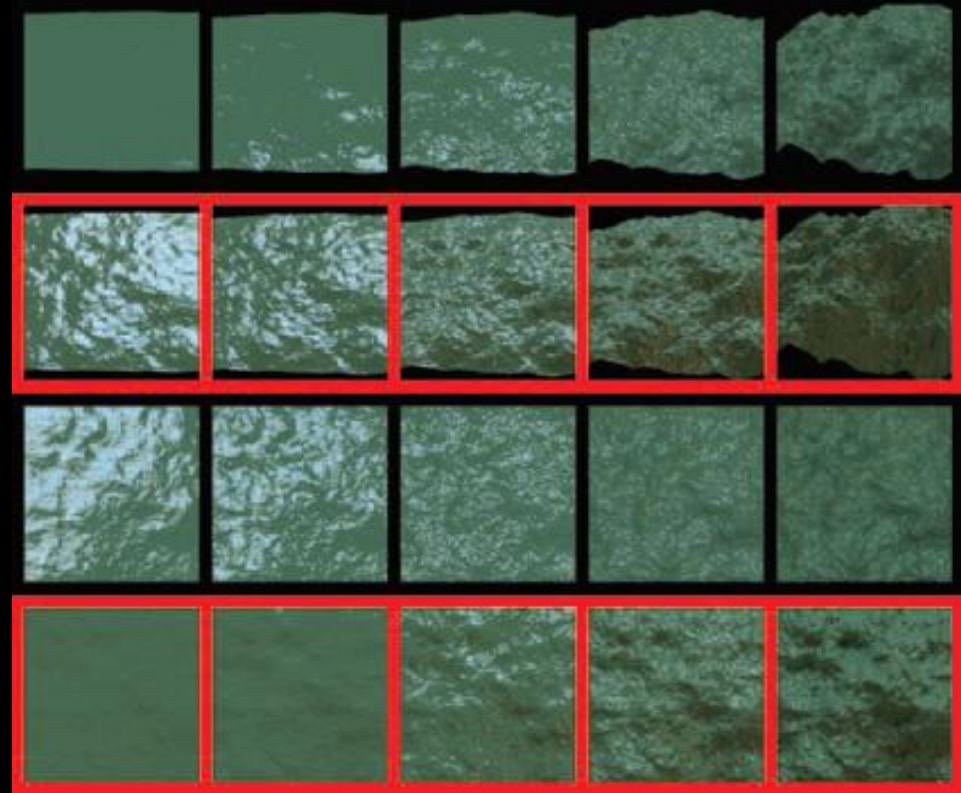
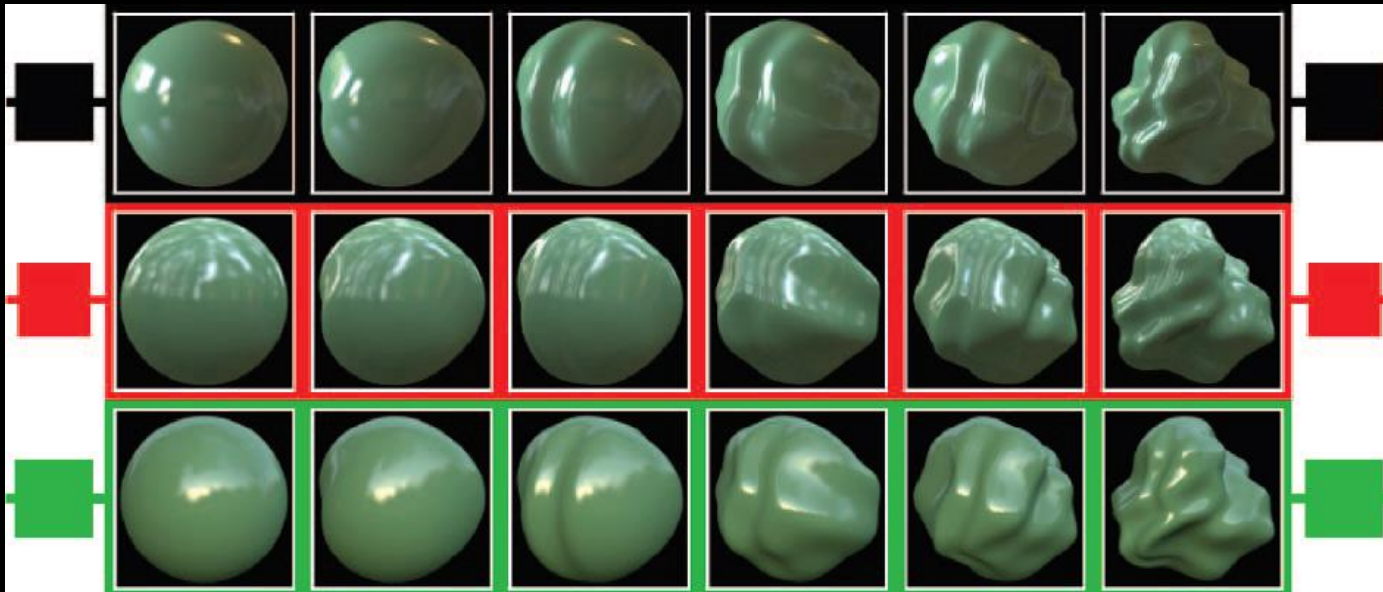


A Sole, I Farup, P Nussbaum, S Tominaga, Evaluating an image-based bidirectional reflectance distribution function measurement setup,, Applied Optics 57 (8), 1918-1928, 2018

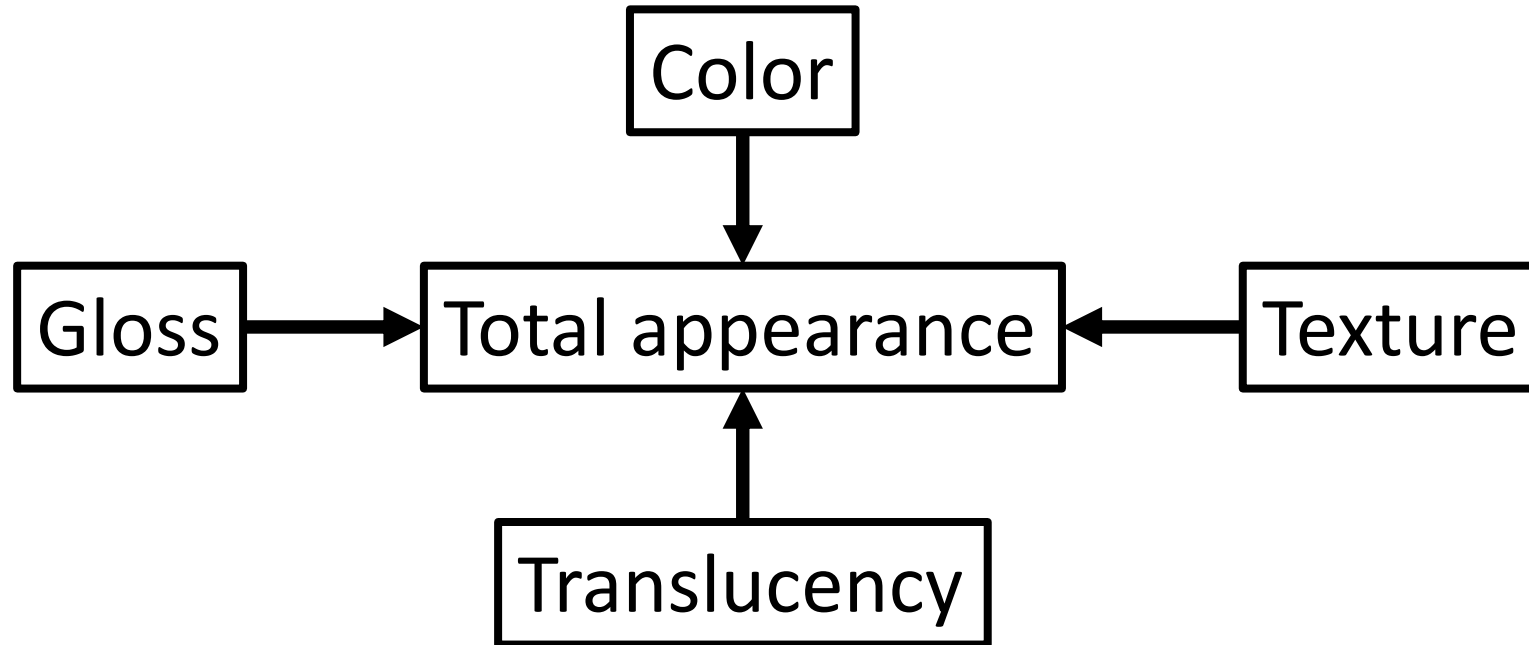


H. W. Jensen, S. R. Marschner, M. Levoy, and P. Hanrahan,
“ A practical model for subsurface light transport”, SIGGRAPH, 2001

Phillip J. Marlow, Barton L. Anderson; Generative constraints on image cues for perceived gloss. *Journal of Vision* 2013;13(14):2. doi: 10.1167/13.14.2.



Metrology



Mostly material, situation is discarded

Independent perceptual attributes

Difficult link to physical correlates

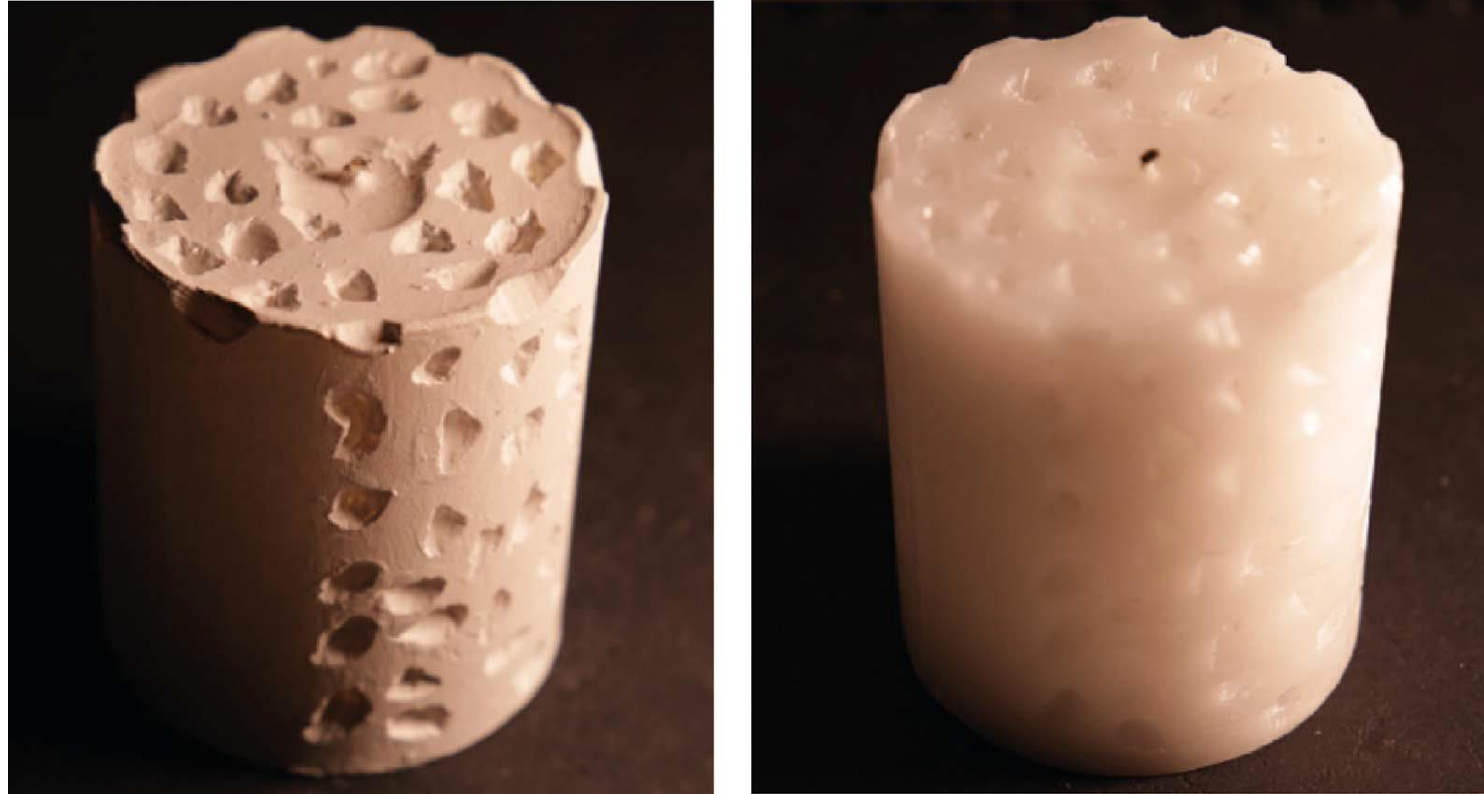
Definitions?



Lea
Glossy

Glossy

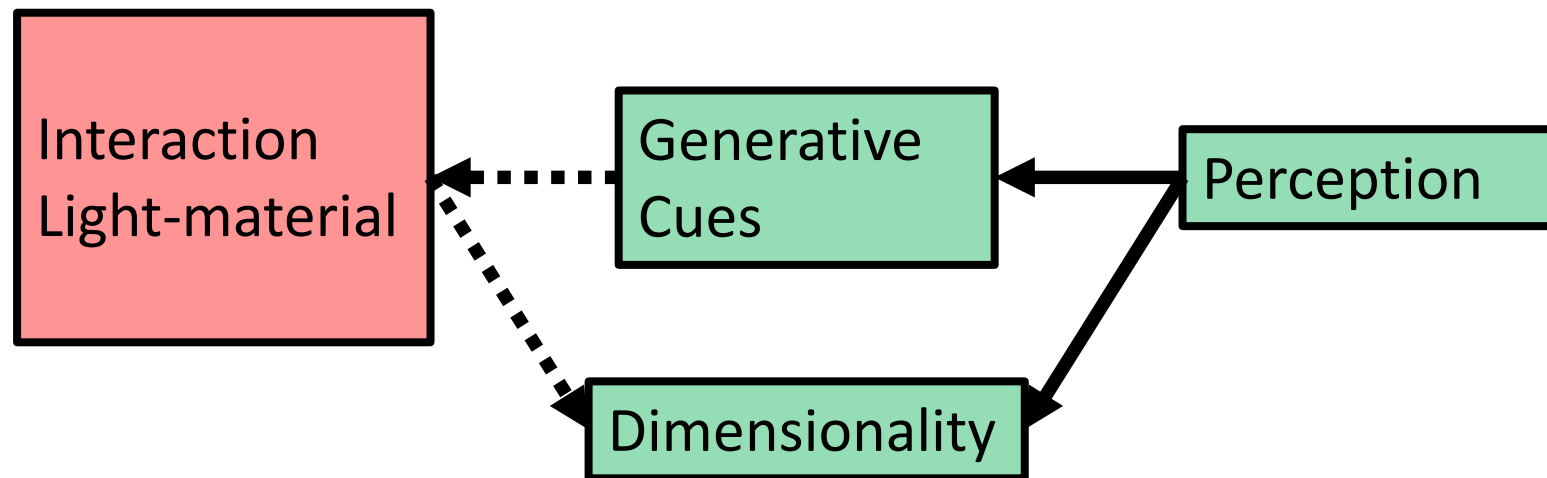
Perception changes with appearance



Perceived shape change with different translucency level (and so does it for a camera)

Nahian S. Chowdhury, Phillip J. Marlow, Juno Kim; Translucency and the perception of shape. *Journal of Vision* 2017;17(3):17. doi: 10.1167/17.3.17.

Psychology



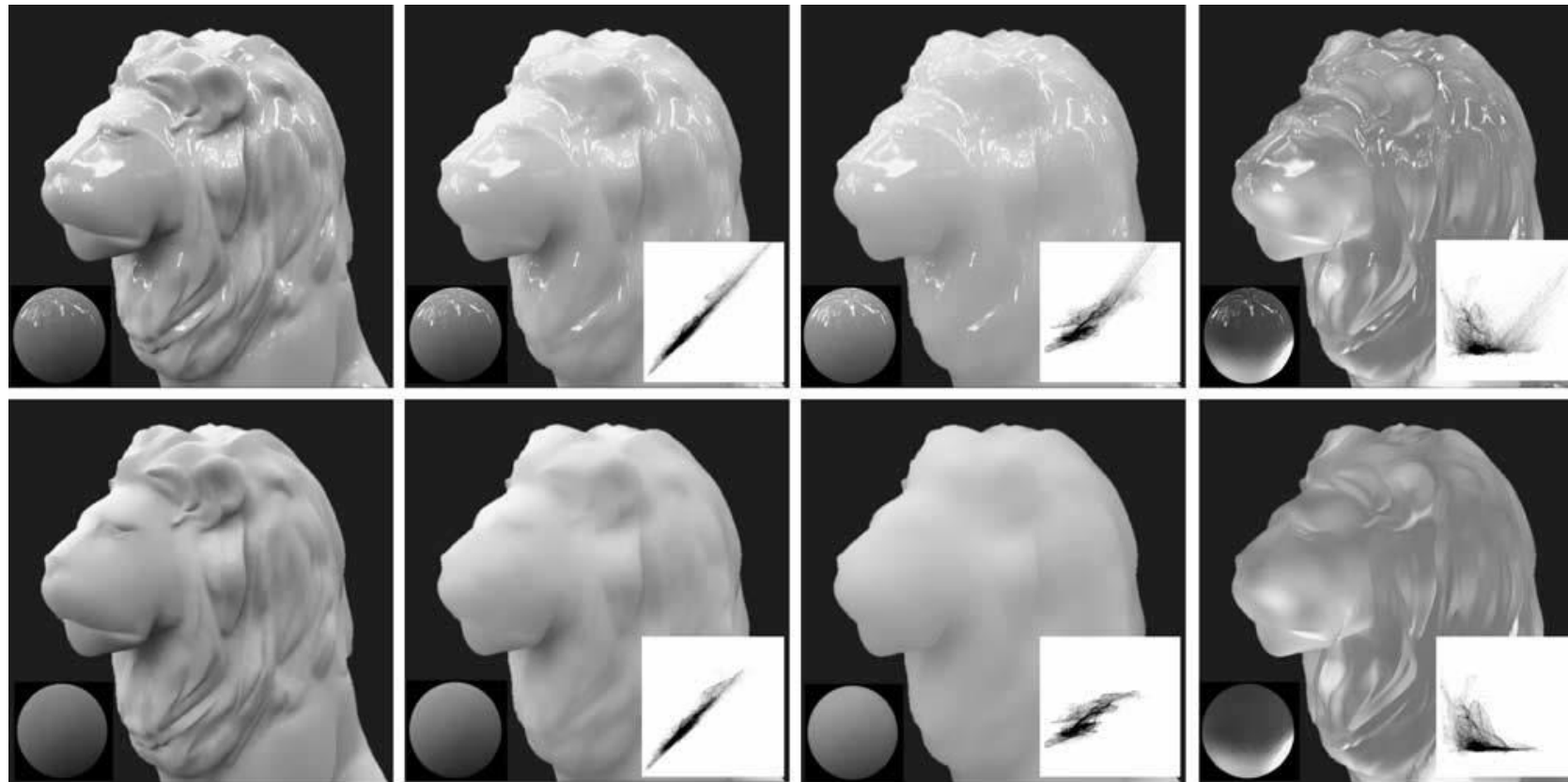
Mostly oriented
towards
perceptual
models

Many quantitative
research on
peculiar aspects
based on
computer
graphics

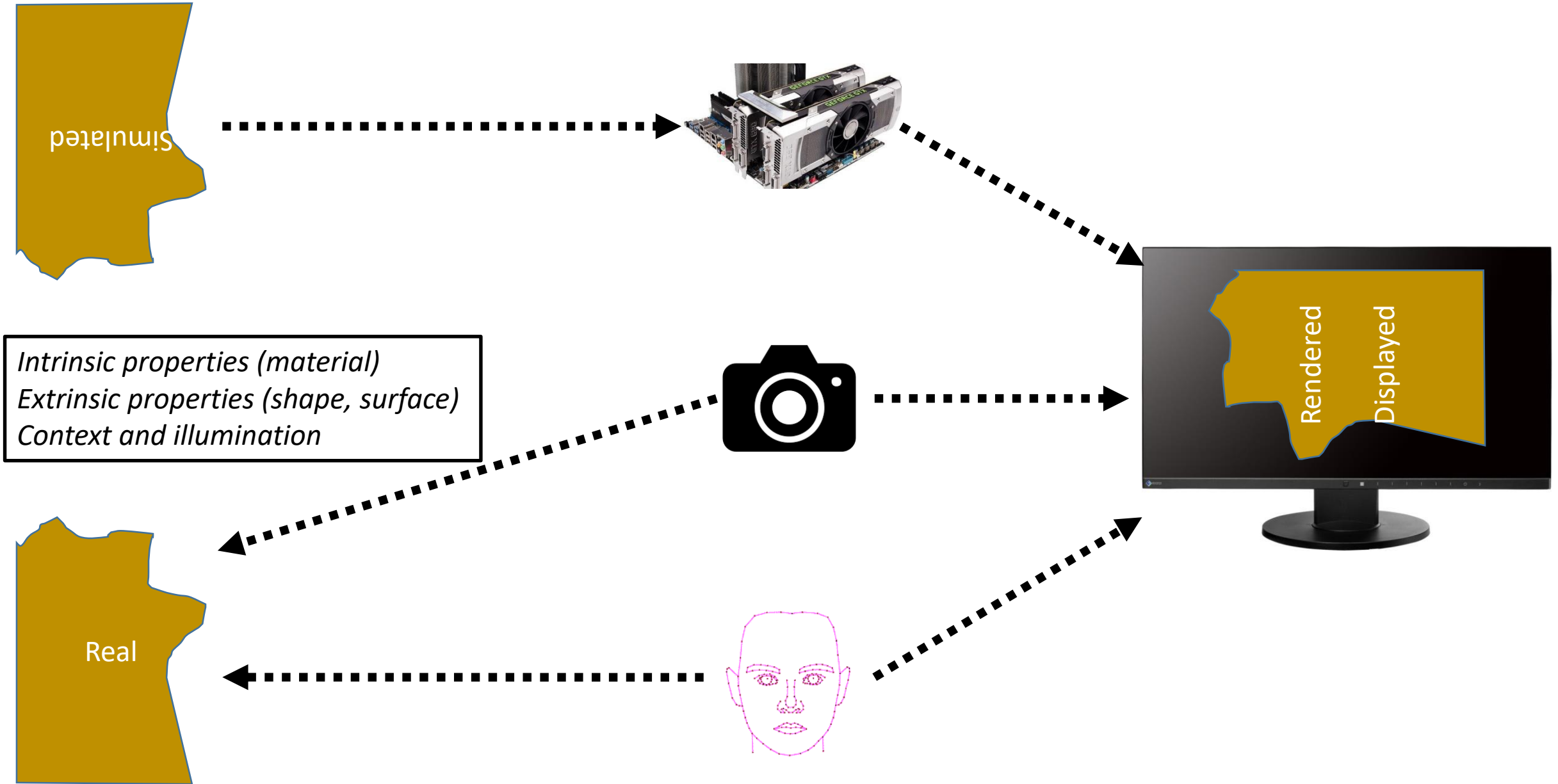
Difficult to avoid
bias due to
physical modelling

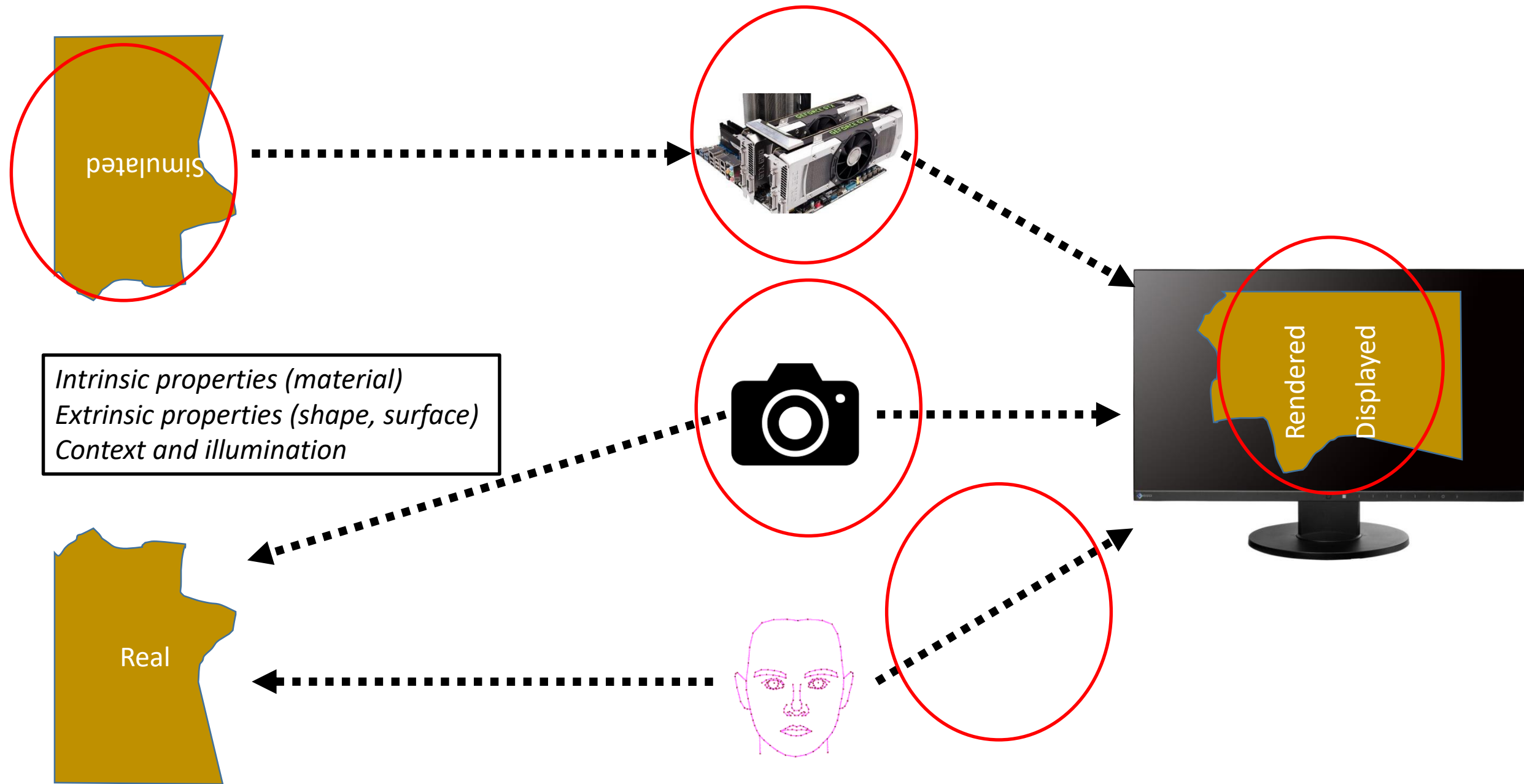
Complete physical description is probably not needed, only the cues generative of perception may be of interest

Roland W. Fleming and Heinrich H. Bühlhoff. Low-level image cues in the perception of translucent materials. *ACM Trans. Appl. Percept.*, 2(3):346–382, July 2005.



Isamu Motoyoshi; Highlight–shading relationship as a cue for the perception of translucent and transparent materials. *Journal of Vision* 2010;10(9):6. doi: 10.1167/10.9.6.





Simulated

Intrinsic properties (material)
Extrinsic properties (shape, surface)
Context and illumination

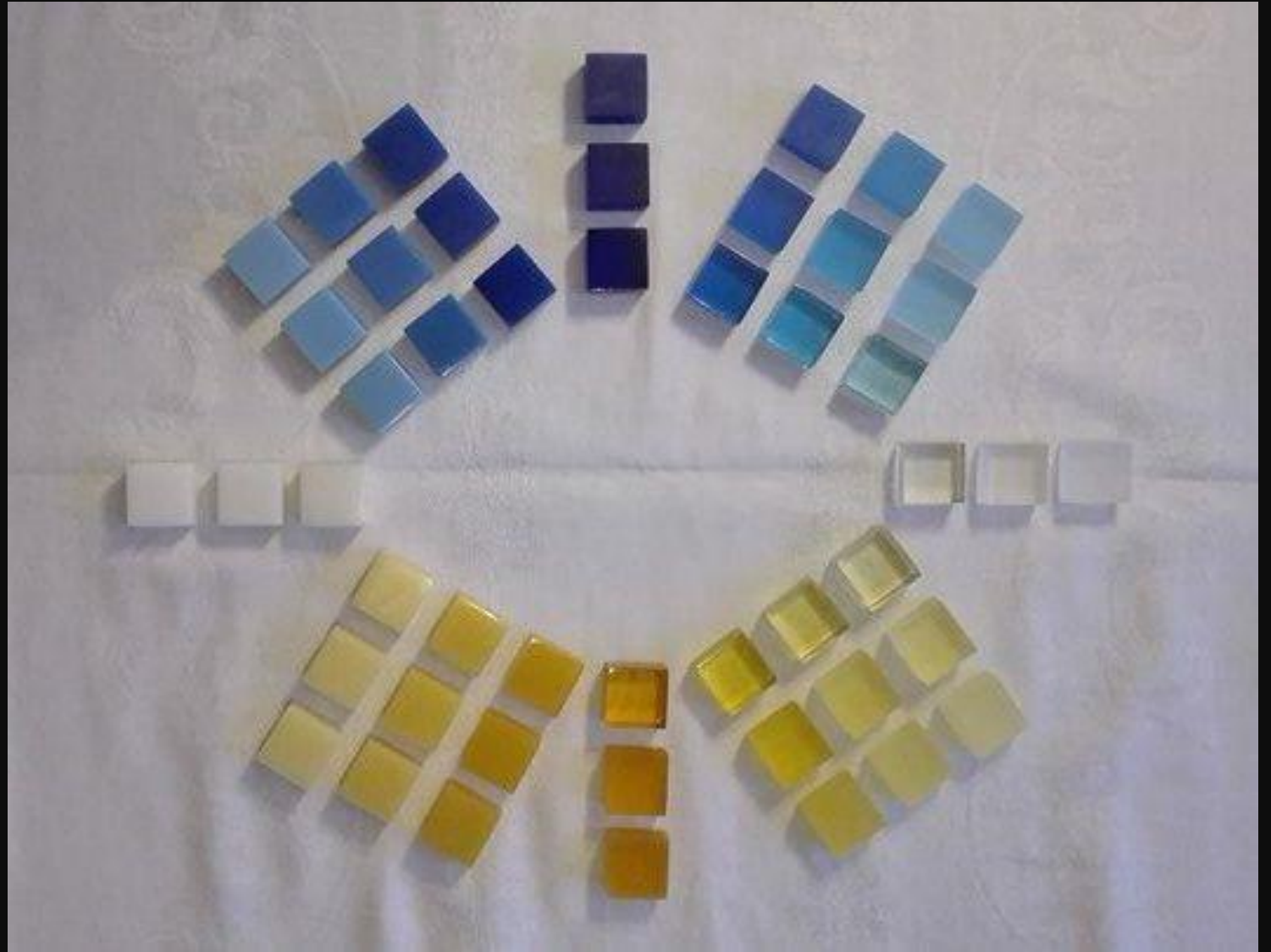
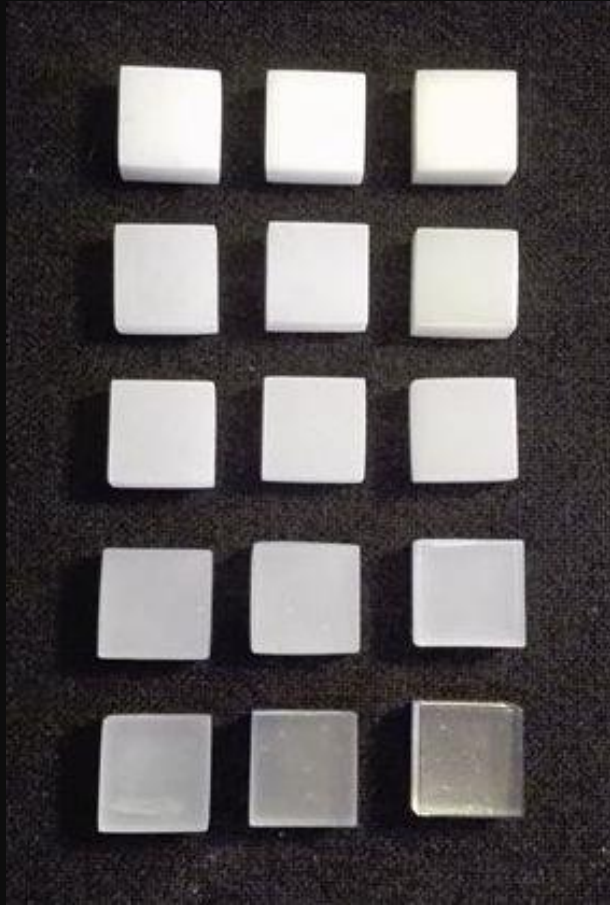
Real

Rendered
Displayed

A collection of (real) objects?

- Generate research hypothesis through qualitative research methods
- Verify quantitative models – Fast prototyping
- Experience visual perception (for researchers)
- Communicate about visual perception (to others)

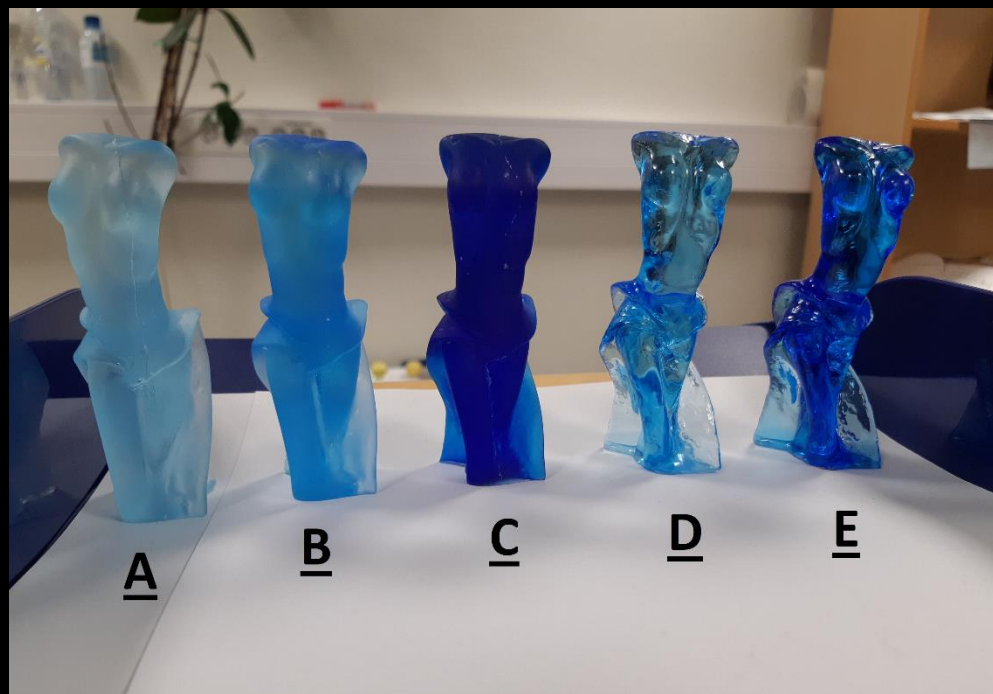
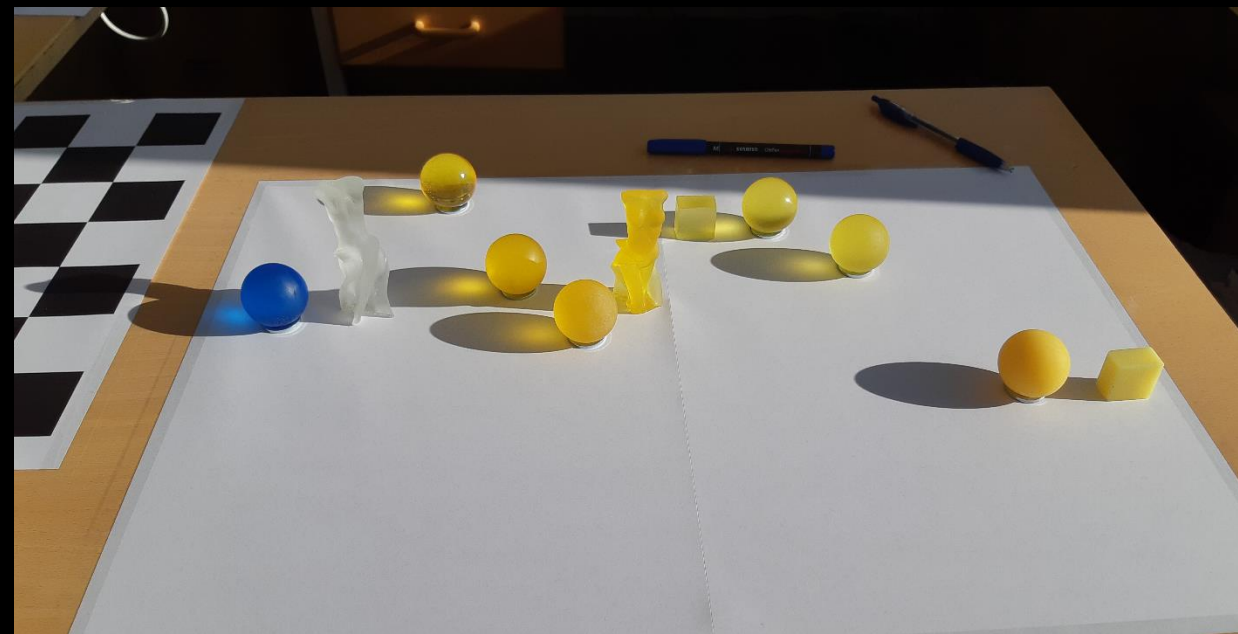
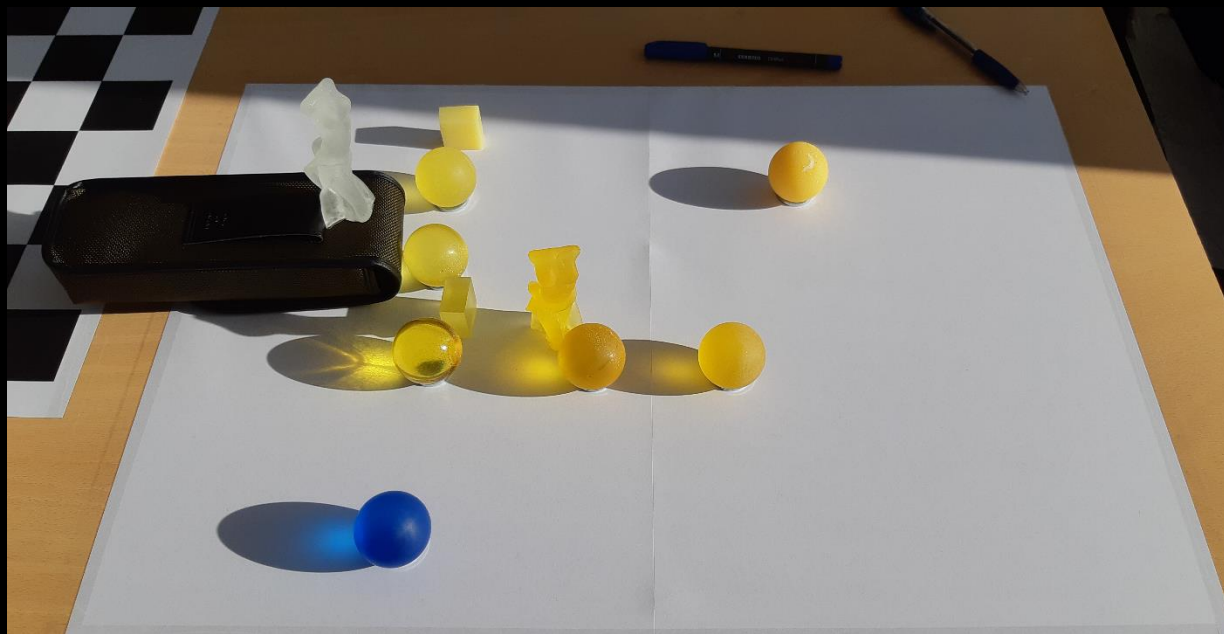
Thomas J-B, Deniel A and Hardeberg JY (2018), *"The Plastique collection: A set of resin objects for material appearance research"*, In Proceedings of the XIV Conferenza del colore. Firenze, Italy, September, 2018. , pp. 1-12.













Qualitative research method

- The *grounded theory analysis* is a qualitative research methodology derived from the *grounded theory approach*, which emerged within the Chicago School of Sociology
 - Glaser, Barney G and Strauss, Anselm L, “The Discovery of Grounded Theory”, Chicago, Aldine Publishing, 1967.
 - Paillé, Pierre, “L’analyse par théorisation ancrée”, in French, Cahiers de recherche sociologique, (23), 147–181, 1994.
- Specific features of this method
 - Researcher progresses also while doing the analysis
 - Corpus of data is not static
 - Less interpretative than many others

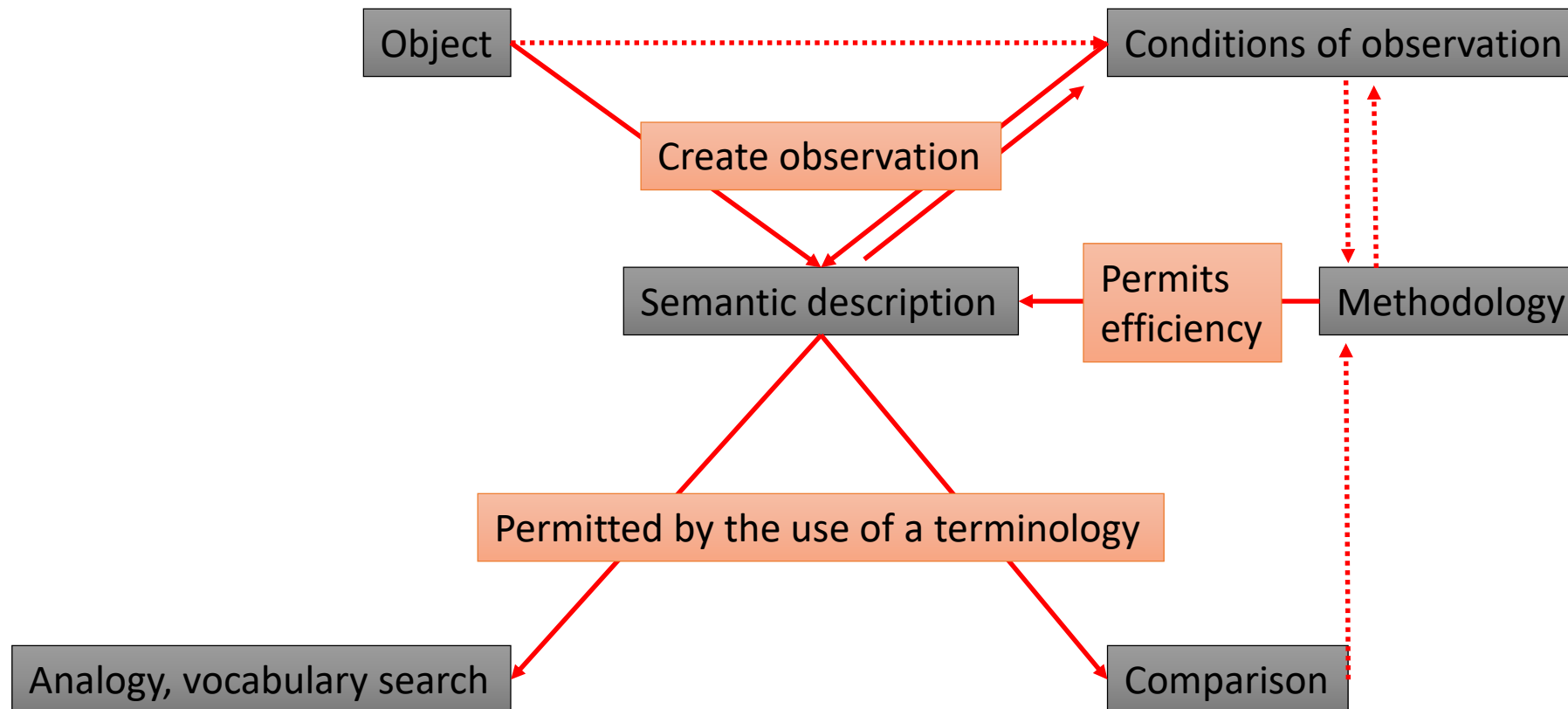
Qualitative research method

Codification
Categorization
Co-linking
Integration
Modelling
Theorization

Example of qualitative results

- Interview of the artist (4 sessions)
- Split in 2
 - Technical process: Factual analysis
 - Qualitative description process: Qualitative analysis
- Originally intended to understand material appearance processes
 - ...
- End-up with an observation on 'how difficult it is to describe appearance'
 - Including a model of appearance description and its dynamics
 - But include also, hints on how material is perceived, described or evaluated

(Semantic) appearance description process



Categories: Semantic description

- Tentative to name, to describe
- To define (semantic tentative of general definitions)
 - E.g. 'Matte: for paints or enamels that do not send back the light and hide surface defects and textures'
- Failure!
 - In many occasions 'I do not know how/what to say.'
- Analogy as strategy
 - Milky, veil, foggy, like water, etc.
 - Color names
- Defaults as hints
 - We can see the bubbles in this situation / for this object / for this transparency

Categories: Methodology

- Convergence of description processes
 - Until convergence there is often failure in description
 - Convergence aims at faster interpretation and feeling of safety, continuity
- Proposition of methods for observation
 - Change light, specify geometries, etc. until comparison is made possible
- After a few tries, convergence happens
 - In vocabulary and in conditions so the analysis becomes 'systematic'.
- Several tentatives of generalisation (very dangerous and very weak)
 - Of comparison, of protocols, of impression, etc.
 - Usually valid only for a short time due to samples diversity

Categories: Conditions of observation

- Illumination
 - Sources
 - Optical effects
 - Description depends on the light source
- Viewing geometry
 - Lot of possibilities
 - Description may differ a lot
- Background
 - Dark or clear
 - Scenes/objects
- **Strong impact on all perceptual attributes!**

Categories: Object

- Shape
- Surface
- Size
- Specific light effect
 - *e.g.* Spheres generate a 'halo' on the surface where they are put on.

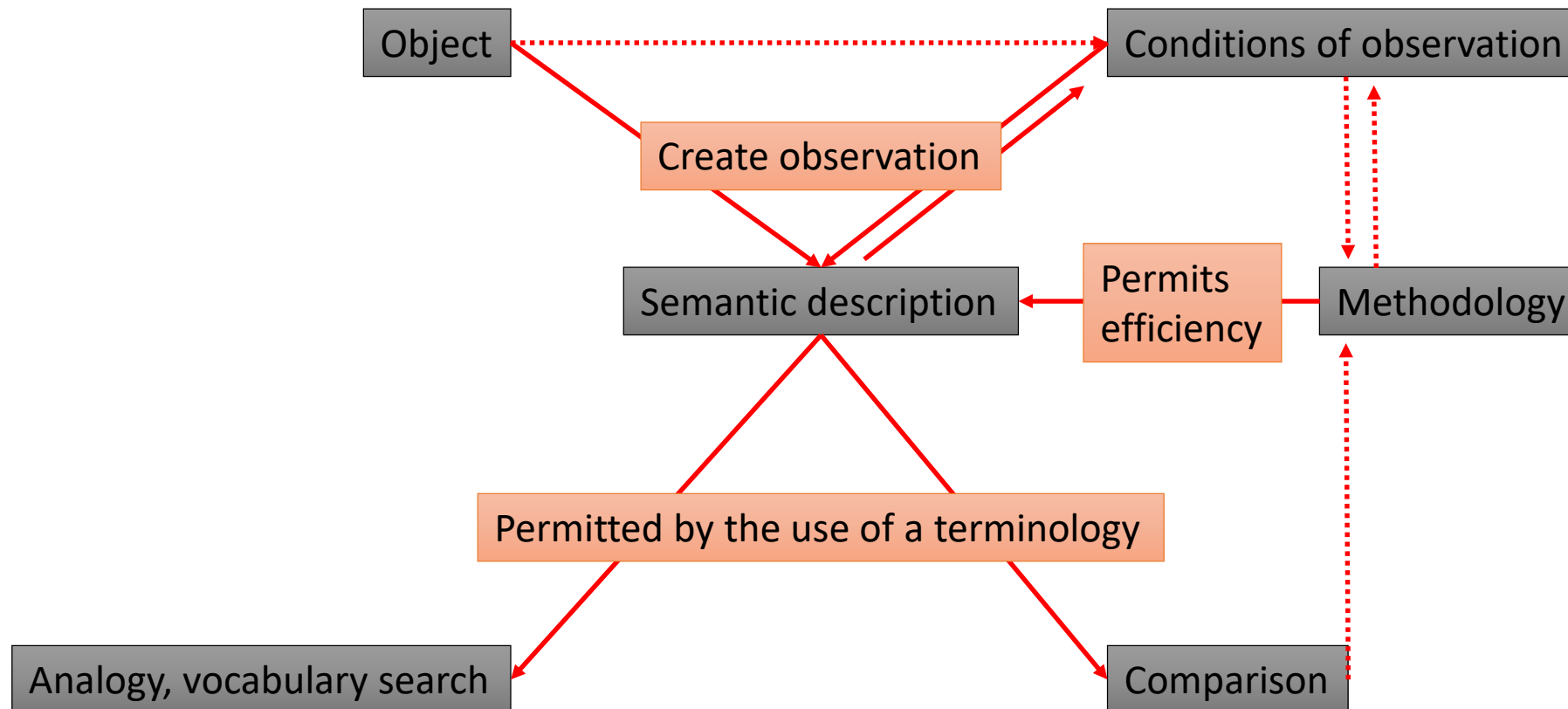
Categories: Comparison

- Similarity
- Difference
- Changes
 - Between N-1 and N object, iterative changes.
- Scales
 - ‘We see the opposite angles’, ‘we see a shape/shadows through’, ‘we recognize the objects behind’
- Naive expression of a physical model
 - ‘In this yellow object, we see the structure through, but less clear than in the blue variant’
 - ‘For all glossy objects, more light goes through’
 - Fundamental optical differences between the blue and yellow objects (waiting for the optical measures)
- Need of reference
 - To see an object through
 - To see the light through
 - More or less than another object (of the same or of different shapes)

Categories: Analogy

- Need to invent/define a gradual terminology
- Color naming very important
 - Very rich vocabulary (*e.g.* aigue-marine, more than 15 color names)
 - Use of atlas (especially from make-up industry – material based color description)
- Analogical naming
 - Like water, fog, etc.
- Appearance related
 - Matte, satin, glossy (as Brillant in French)
 - Transparent, translucent, opaque
 - Opalescent, iridescent

(Semantic) appearance description process



Perspectives and limits

Corpus of objects

- Simple material, theoretical objects (spheres and rectangles)
- Homogeneous material
- No specific use of the objects

A single observer (one specific individual)

- An expert in appearance has performed a very fast description of objects in terms of translucency, gloss, color and texture, yet this was very limited
 - No texture, very translucent, blue, quite glossy
- One artist, in a given language, French

We do not claim any generalization!

This is only an observation of a collection of data: the interview

Conclusion

A – We need to define the terms, the situation(s) and the reference(s)

B – We need to identify trends and to write them as laws

C – We need to create appearance specification

Take home: While defining the perceptual color spaces, we should keep a link to spatial



Before and after cleaning of a daguerreotype, Source: Picquery.com



ApPEARS

APPEARANCE PRINTING

European Advanced Research School

<http://www.appears-itn.eu>



CULTURAL HERITAGE ANALYSIS
FOR NEW GENERATIONS

<http://www.change-itn.eu>



Before and after cleaning of an altarpiece, courtesy of University of Oslo.