

Quantifying appearance

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Please do not sue me if you see material
that is not properly referred to.
I do not make money out of this:
Send me a message and I will fix it!

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Researcher at NTNU (Sabbatic 2016-2019)

The Norwegian Colour and Visual Computing Laboratory

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Associate Professor at Université de Bourgogne since 2010

LE2I

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



Appearance of an object or material

Material Appearance

What Color?
Glossy/matte?
Texture?
Opaque/translucent?

Objective description

Physical Measurements

Surface reflectance,
Specular measurement,
texture patterns,
Opacity,
etc.



MUVApp

Intro to the project

Measuring appearance

Definition of research paradigms

The *Plastique* collection

Objects for material appearance research

MUVApp project (FRIPRO Toppporsk)

- Budget: 25 MNOK
 - Fellesløft – 50% by NTNU, 50% by RCN
- Timeframe: 5 years – 2016-2020
- Project leader: Jon Y. Hardeberg
- Administrative manager: Aditya Sole
- WP leaders: Peter Nussbaum, Marius Pedersen
- Selected leading international partners and scientific advisory board

Measuring and Understanding Visual Appearance



Appearance attributes:
Colour, Gloss, Texture,
Translucency



Measurement of visual appearance

- Review available measurement techniques to assess goniochromism and the different gloss attributes.
- Develop imaging BRDF measurement techniques and extend to measurement of 3D shapes in different illumination and viewing geometry.
- Develop methodologies to measure the spatially-varying Bidirectional Surface Scattering Reflectance Distribution Function (sv-BSSRDF)

Understanding Appearance

- Investigate effect of statistical parameters of an image on material appearance.
- Develop quantitative model to predict visual appearance of material from physical measurements.
- Study effects of ambient surroundings on material appearance perception using virtual and augmented reality.

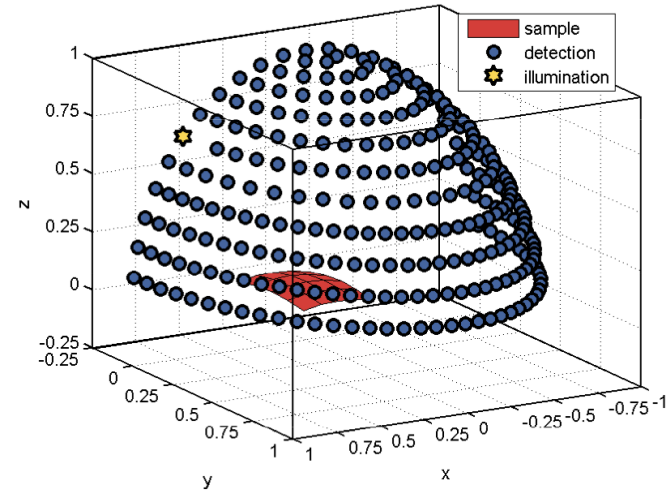
How to achieve accurate appearance reproduction?

GONIO-MEASUREMENTS / MULTI-ANGLE MEASUREMENTS

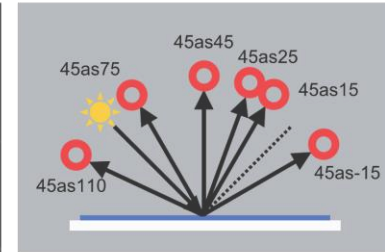
- Multi-angle measurement instruments available in the market,
- X-Rite MA98, BYC-MAC, etc,
- Gonio-reflectometers at metrology institutes.

Limitations:

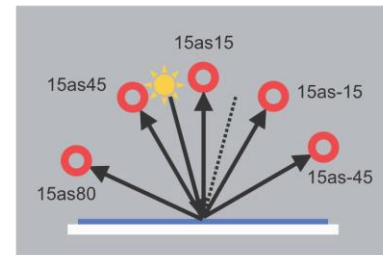
- Measurements are time consuming (especially Gonio-reflectometers),
- Expensive.



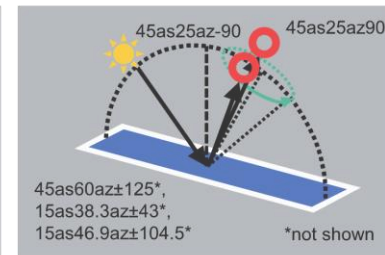
(a) Photo of MA98



(b) Sketch of medium illumination and in-plane detection



(c) Sketch of steep illumination and in-plane detection



(d) Sketch of medium illumination and out-of-plane detection

Figure 3-6: Multi-angle spectrophotometer MA98

Images taken from:

K. Kehren, *Optical Properties and Visual Appearance of Printed Special Effect Colors*, PhD thesis, Technischen Universität Darmstadt, Darmstadt, Germany, April 2013.

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LINK BETWEEN GLOSS AND CONTRAST

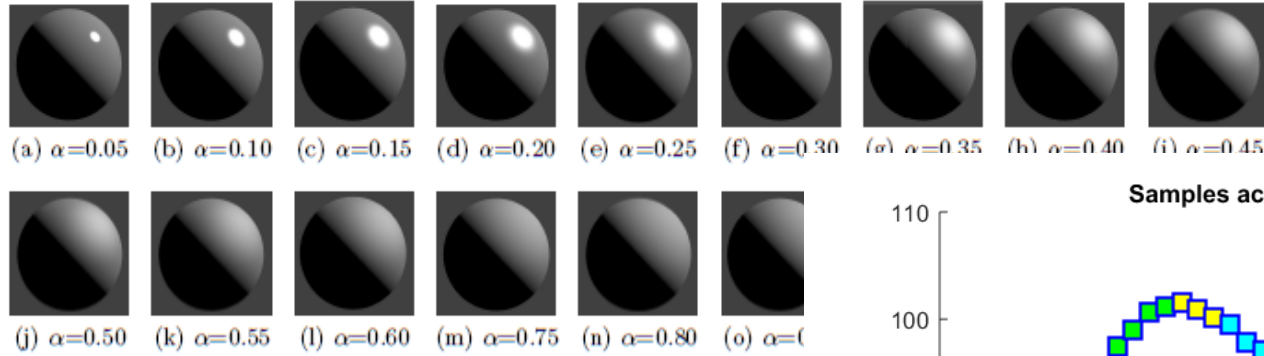


Fig. 1. Images of spheres showing BRDF properties defined by the Wards model. Here, $\alpha \in [0.05, 1.00]$.

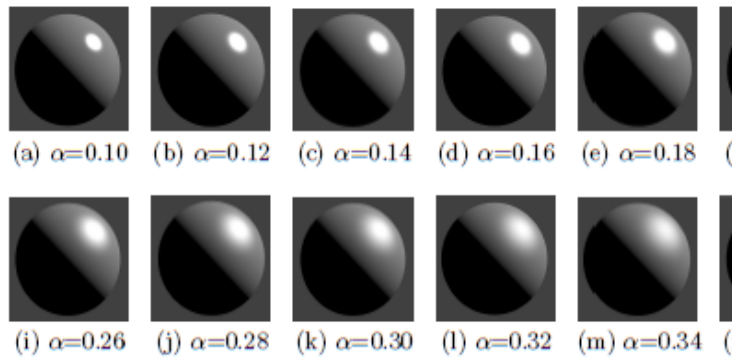
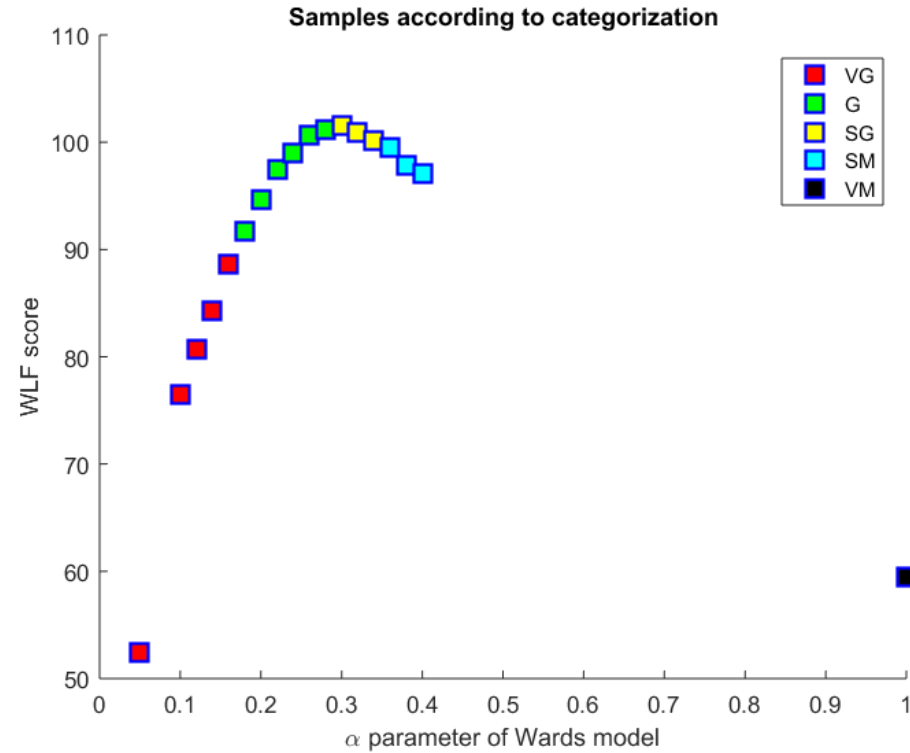
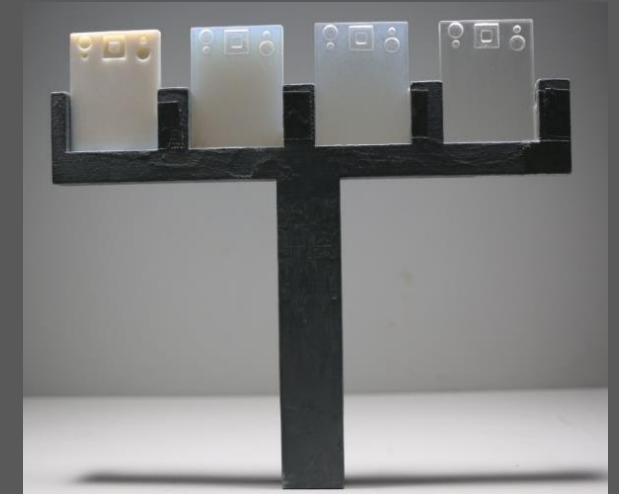


Fig. 2. Images of spheres showing BRDF properties defined by the Wards model. Here, $\alpha \in [0.10, 0.40]$. Note that for the experiment, we have added $\alpha = 0.05$ and $\alpha = 0.40$.



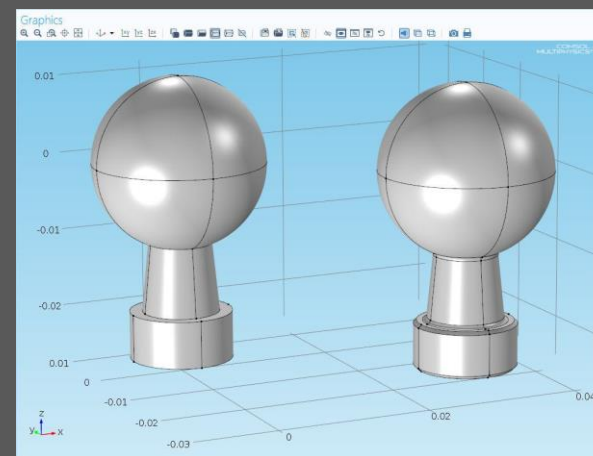






Bui Minh Vu, Tejas Madan Tanksale, Philipp Urban and Shigeki Nakauchi, **Visual perception of 3D printed translucent objects**, *24th Color and Imaging Conference*, pp. 94-99, San Diego, USA (2016)







Lip Drip Artist Vlada Haggerty Sues Make Up For Ever for Copying Her Trademarked Work

"We need brands to respect individual artists! I think it's important to speak up and not let it slide."



By [Carly Cardellino](#) Jan 9, 2018

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VLADA HAGGERTY, MAKE UP FOR EVER, MYLAN TORRES

MORE FROM BEAUTY



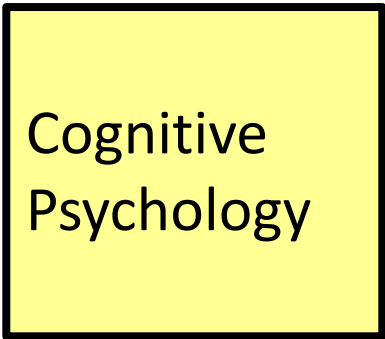
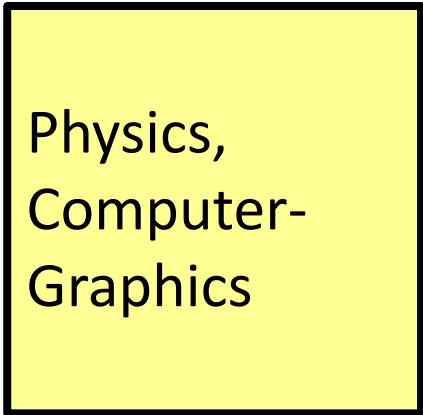
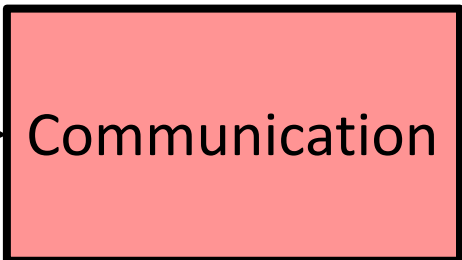
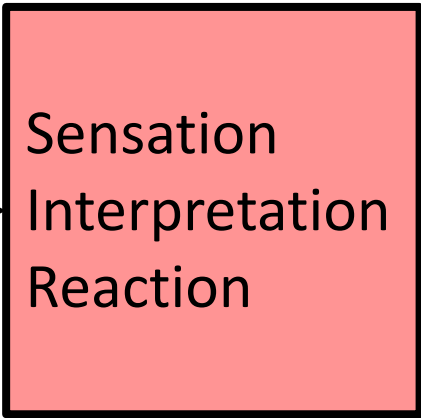
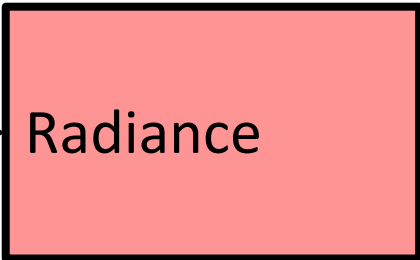
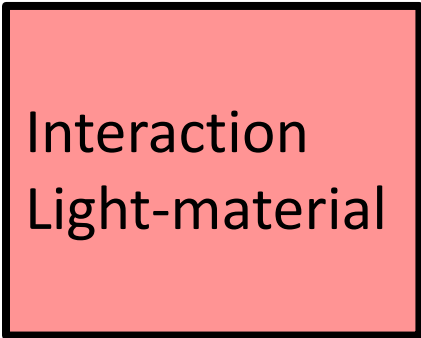
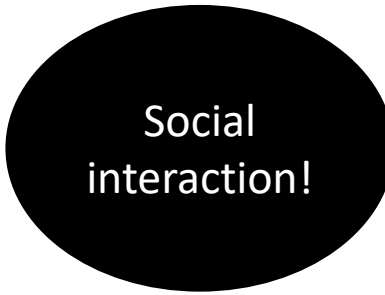
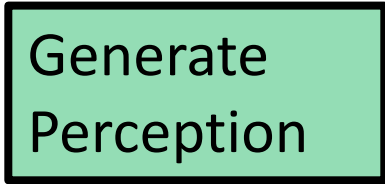
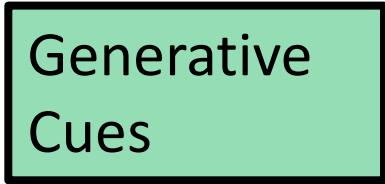
Tarte Released a Magical Mermaid Collection

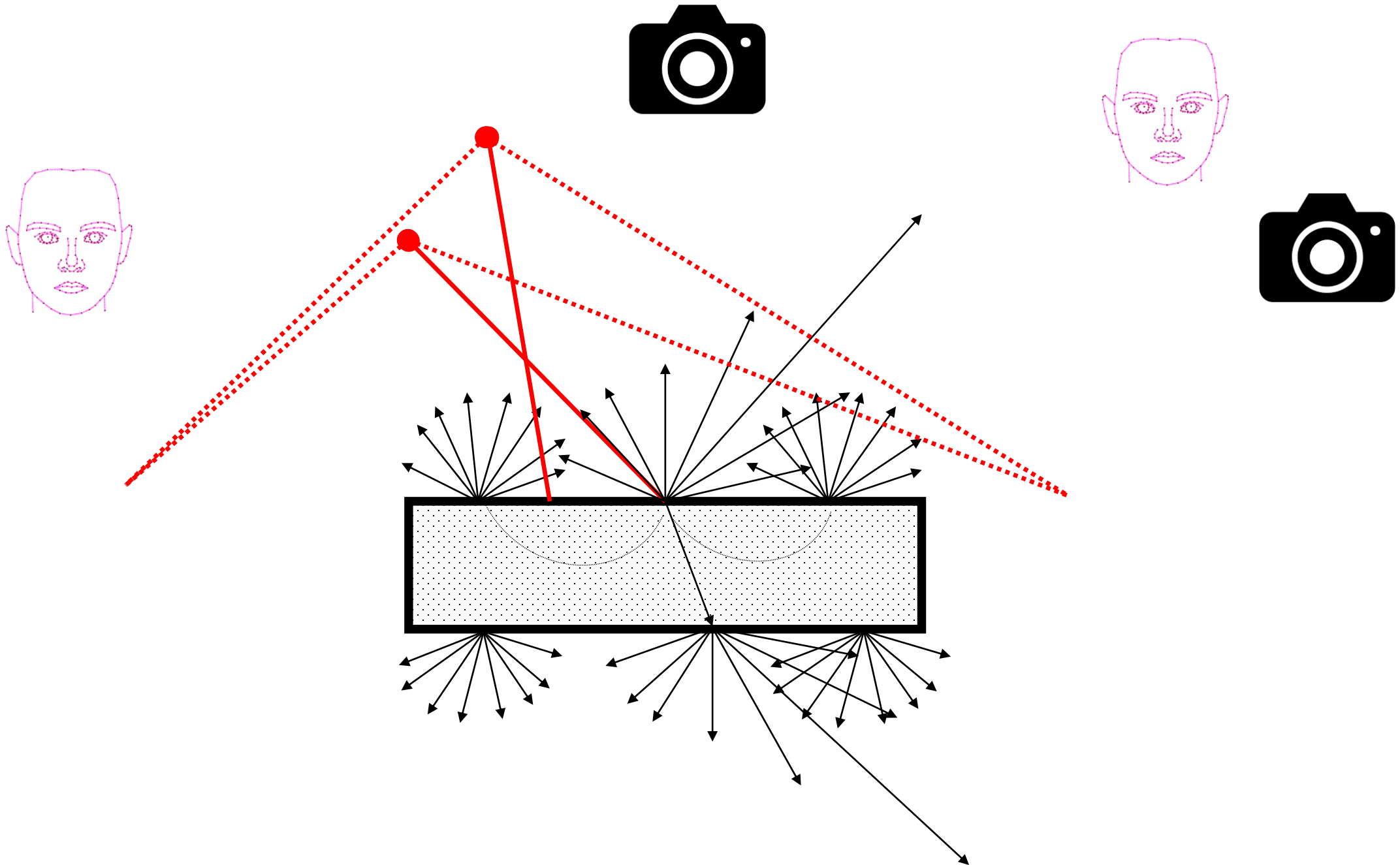




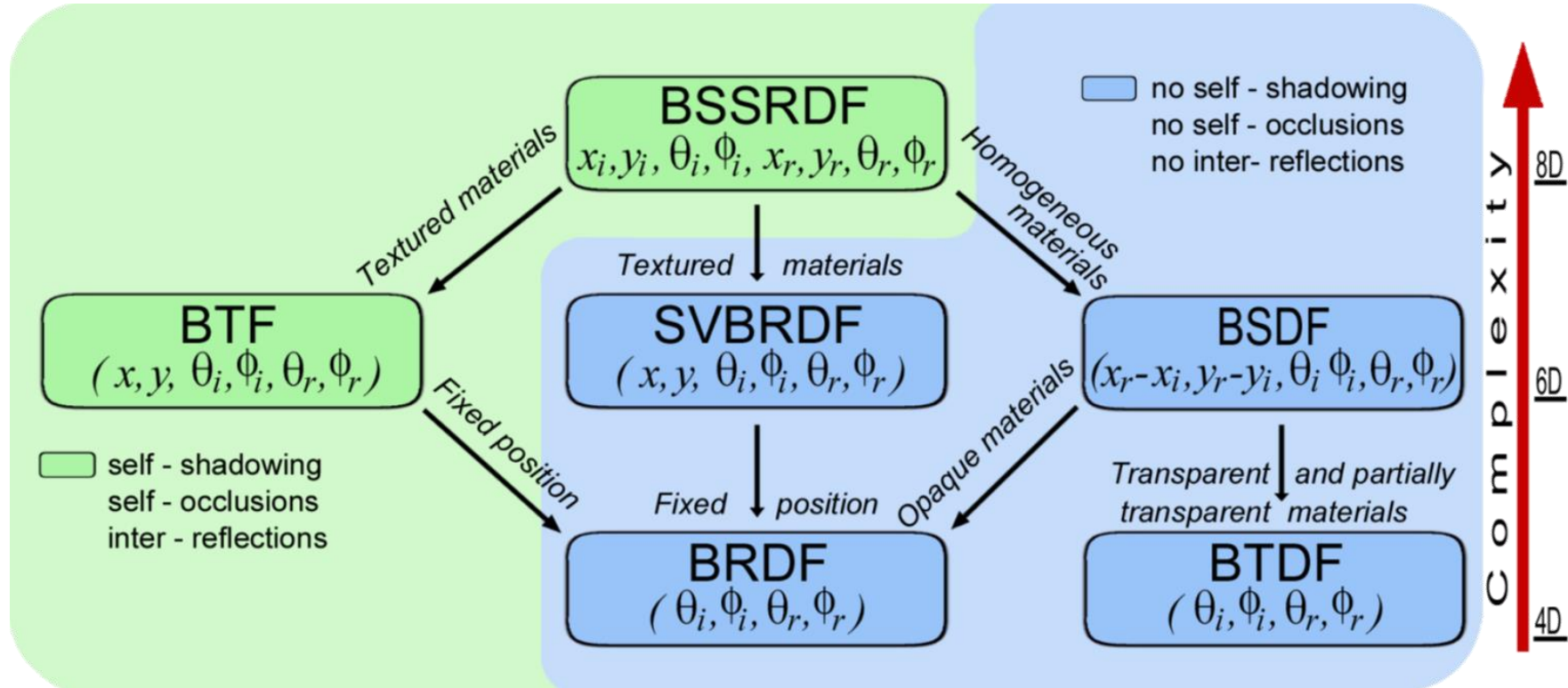








Physics and computer graphics



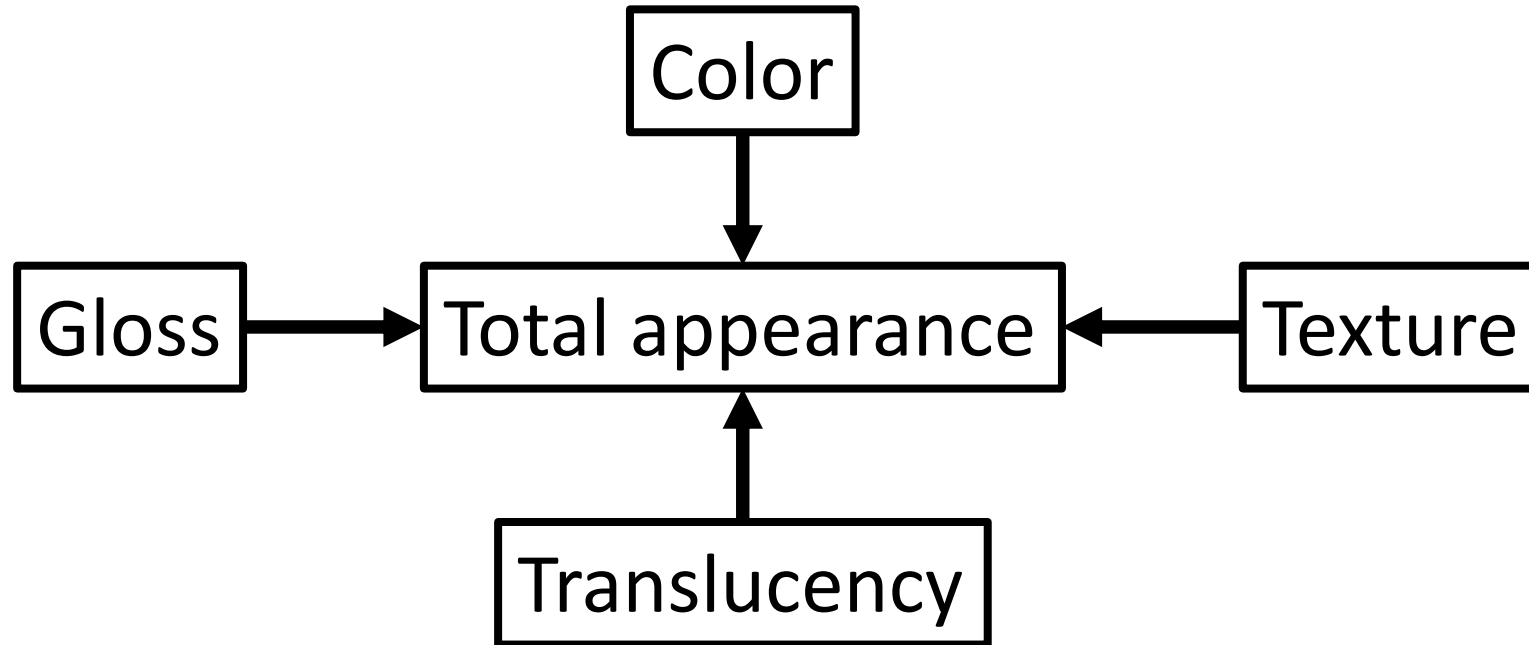
Mostly no inverse model

Many data and complexity

Difficult to measure and to model

Relation with perception?

Metrology



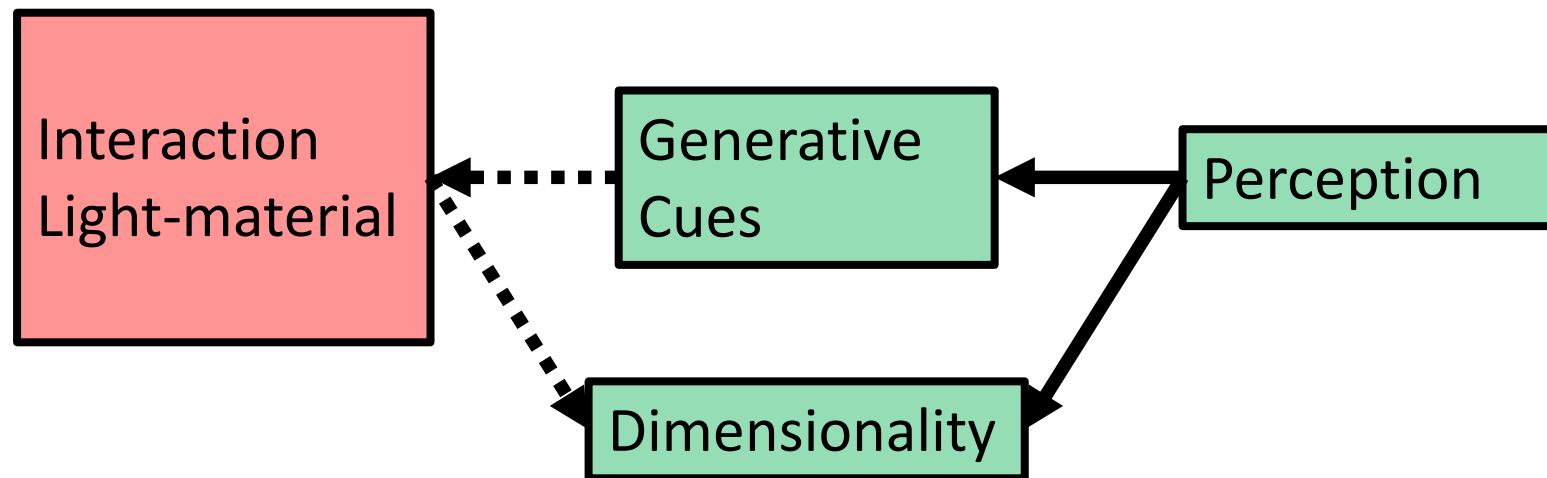
Mostly material, situation is discarded

Independent perceptual attributes

Difficult link to physical correlates

Definitions?

Psychology



Mostly oriented towards perceptual models

Many quantitative research on peculiar aspects based on computer graphics

Difficult to avoid bias due to physical modelling

Research statement:

There is a gap between
the physical measurements and the generative cues

We could fill it with image based measurements, image statistics, etc.

Beside the technical problems:

Definitions are not the same depending on the fields

Generative cues are difficult to identify

Difficulties of communication

...

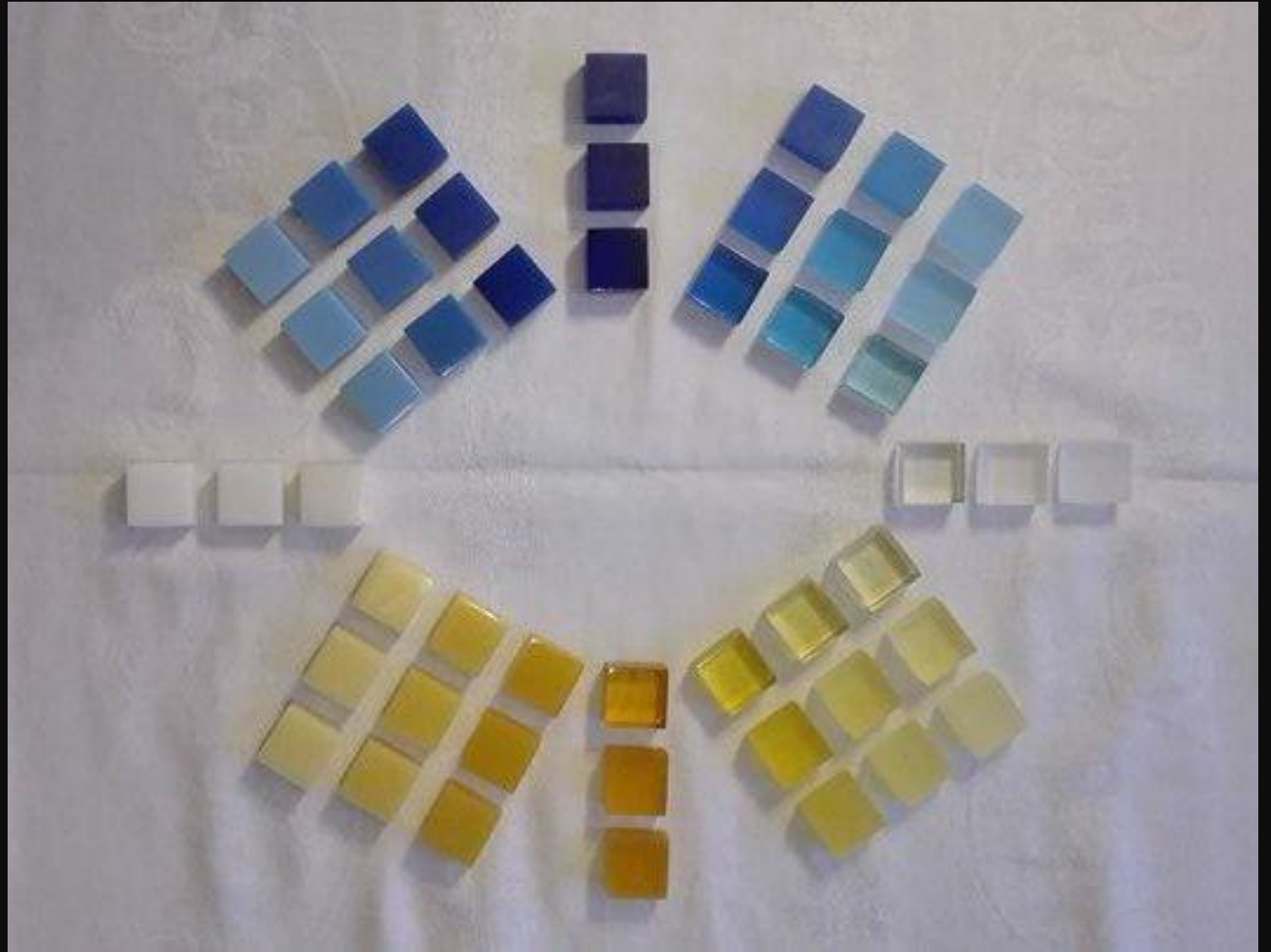
The *Plastique* collection: A set of resin objects for material appearance research

Jean-Baptiste Thomas, Aurore Deniel, Jon Y. Hardeberg

To be presented at Conferenza del colore, Italian color group

Why 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)









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 some others

Qualitative research method

Codification

Categorization

Co-linking

Integration

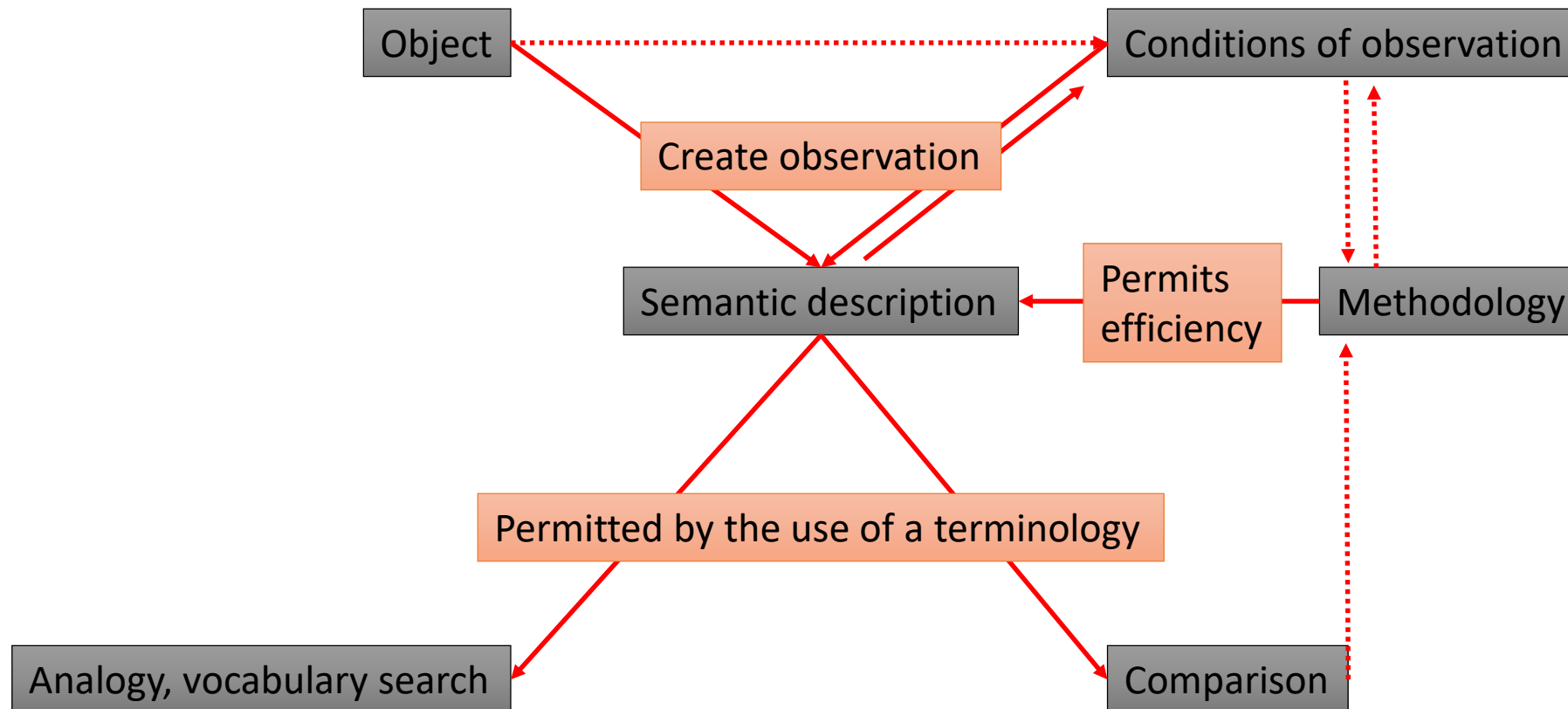
Modelling

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 dynamic
 - But include also, hints on how material is perceived, described or evaluated

(Semantic) appearance description process



Perspectives and limits

Corpus of objects

- Simple, 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

The collection of objects is already used.

The qualitative model of description permits to formulate a few questions:

- Conditions of observation and constancy?
 - Continuity on qualitative research
 - Ongoing experiment
- Semantic communication of appearance
 - If we do not develop/understand the semantic proposition (what is permitted by language), we will surely not be able to propose adequate general definitions
- Metrology
 - The fact that there is a search for reference/comparison is a good hint that we surely can provide a measure eventually. How do we identify the reference-s?

