Sensory Analysis techniques for materials selection in the education and in the industry context

A. Piselli[a,b], M. Simonato[b], B. Del Curto[c]

[a] Politecnico di Milano, Design Department, Milano, 20158, Italy
[b] The Research Hub by Electrolux Professional, Pordenone, 33170, Italy
[c] Politecnico di Milano, Chemistry, Materials and Chemical Engineering Department "Giulio Natta", Milano, 20131, Italy

RESEARCH FIELD

Professional appliances are characterized by an intense use in harsh environment. **Materials and finishes** employed in professional products **have to fulfil** different **technical requirements**: high thermal resistance, food contact compliance and durability to food chemicals and detergents used in frequent cleaning processes. Moreover, they **have to meet** also **sensorial and intangible properties** required by the professional appliances market: among all, ***smoothness, shininess, elegance, quality, robustness*** and ***reliability***.

The need for the **integration of aesthetical-related properties** in materials selection is particularly evident in **metal replacement case studies**, where a material change could affect the overall quality perception of the product [5].

AIM OF THE RESEARCH

1 – Quantification and integration of sensorial and intangible properties in the materials and finishes selection

Different studies focused on understanding and modelling sensorial properties and intangible meanings of materials [1-4] [7]. Some of them apply **Sensory Analysis techniques** [6], used in the food and cosmetic industry, to **measure, analyse and interpret** the **user-material perception process** translating qualitative properties of materials into a numerical system.

2 – Materials aging influence on perception behaviour

To examine how much **material and finishes changes over time** can **affect consumer's perception**, Sensory Analysis tests have been conducted also on aged material samples.

MATERIALS AND METHODS

- ***Sensory analysis tests***

Among standard Sensory Analysis techniques, **discrimination tests** (Paired comparison) and **descriptive techniques** (Napping®, Ranking test) have been selected and readapted to fulfil the industrial context needs.

- **Sensory attributes**

The descriptors analysed by the tests were selected from literature together with design experts of the company.

- **Assessors** (or test panel)

The panel group is composed by expert and non-expert in materials and by expert and non-expert in professional appliance field.

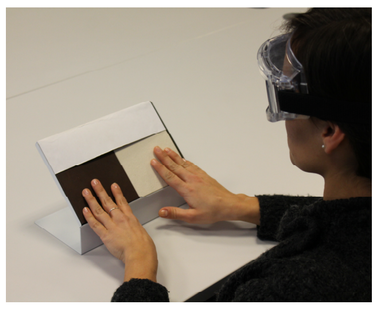
The assessors of the tests, whose results are described in this poster, have been selected from different company departments (Electrolux Professional SpA) and from Politecnico di Milano students (Design & Engineering MD).

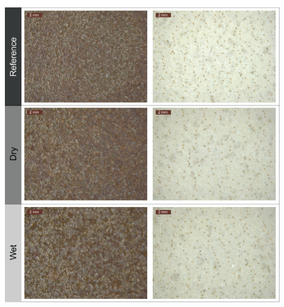
	Sensorial property	Descriptors ENGLISH	Descriptors ITALIAN
Visual	Glossiness	*Shiny – Matte*	*Lucido – Opaco*
	Surface evenness	*Uniform - Non uniform*	*Omogeneo - Disomogeneo*
	Colour intensity	*Intense - Light*	*Acceso - Sbiadito*
	Transparency	*Transparent – Opaque*	*Trasparente - Opaco*
Tactual	Roughness	*Rough – Smooth*	*Ruvido – Liscio*
	Warmth	*Warm – Cold*	*Caldo – Freddo*
	Stickiness	*Sticky - Not sticky*	*Appiccicoso – Non appiccicoso*
	Softness	*Soft – Hard*	*Morbido - Duro*
Intangible	Quality	*Premium quality – Poor quality*	*Alta qualità – Bassa qualità*
	Elegance	*Elegant – Shabby*	*Elegante – Non elegante*
	Innovation	*Modern - Traditional*	*Moderno – Tradizionale*
	Cost	*Expensive – Cheap*	*Costoso - Economico*
	Pleasure	*Like - Dislike*	*Piace – Non piace*

RESULTS AND DISCUSSION

PAIRED COMPARISON TEST - Aged material samples

- **Samples:** 6 samples of sintered ceramic (2 colors)
  - Reference samples (non-aged)
  - Simulation 3 years of use through accelerated life test (Dry and Wet abrasion)
- **Test modality:** only touch
- **Sensory attribute:** roughness





	E	K	ED	KD	EW	KW	Total
E		11	12	12	9	12	56
K	1		2	12	6	11	32
ED	0	10		12	2	11	35
KD	0	0	0		0	4	4
EW	3	6	10	12		12	43
KW	0	1	1	8	0		10

Table 1 - *Users that affirmed that sample in the "row" is rougher than sample in the correspondent "column"*

RESULTS:

- **180 observations** on samples roughness perception:
  - reasonable level of correlation ($p<0.05$);
  - Pearson's chi-squared test ($\chi2 = 80,210$; DF = 25; $P < 0.001$).
- **Roughness evaluation:**

Ref. cream > Wet cream > Dry cream > Ref. brown > Wet brown > Dry brown

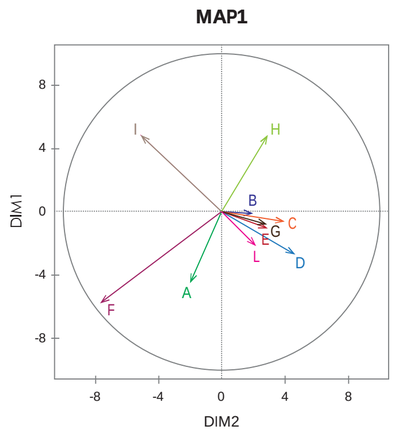
  - dry abrasion impacts on lowering roughness perception ($\chi2 = 9,000$; $P = 0,003$)
  - wet abrasion had a significant effect if compared to dry aging:
    Wet-Dry cream ($\chi2 = 5,835$; $P = 0,016$);
    Wet-Dry brown ($\chi2 = 4,410$; $P = 0,036$).

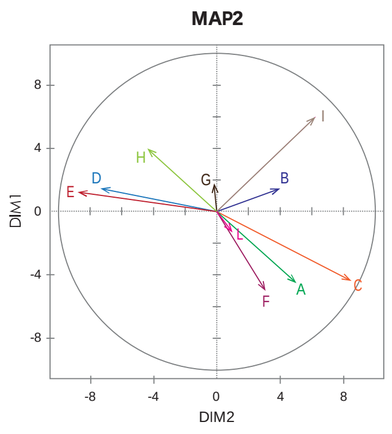
MAPPING TEST - Non-aged material samples

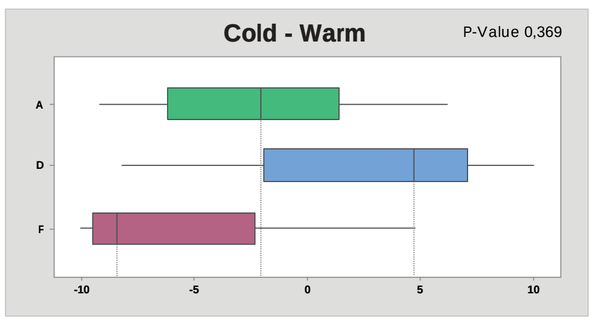
- **Samples:** 10 samples – Metals and metal-look polymers
- **Test modality:** Multimodal (visual + tactual)
- **Sensory attribute:** MAP1 (Warm – Cold/Elegant – Shabby)
  MAP2 (Shiny – Matte/Premium – Poor quality)

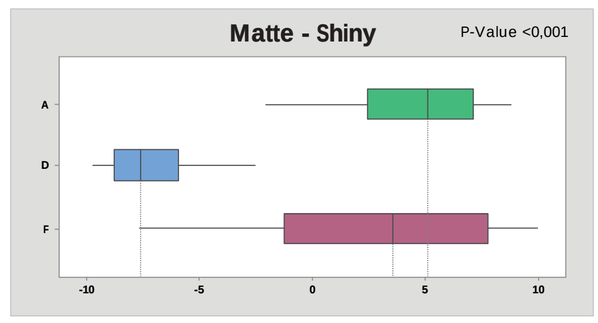
	Bulk material	Finishing
A	PA410 30GF	aluminum PVD
B	PA410 30GF	water transfer printing
C	PARA 50GF	metal-look painting
D	PC/Polyester membrane	metal-look film
E	PA410	50% stainless steel powder
F	AS7G aluminium	sandblasting
G	ABS	metal-look painting
H	ABS	satin labeling (IML)
I	AISI 430	brushing
L	PA410 30GF	stainless steel PVD

Table 2 - *Samples materials and finishing characteristics*









CONCLUSIONS

- **Sensory Analysis tests** valuable instruments to be applied in materials selection;
- Statistical evaluation of results evidences **concordance in user answers;**
- **Metal replacement case studies** particularly suitable for the evaluation of both **qualitative** and **quantitative** properties of materials. It allows also to evaluate **the perception** of **durability of materials and finishes in time;**
- **Further development:**
  - **Ranking test** on aged metal-look samples to rate the level of acceptance by users;
  - **Comparison** of some sensorial properties **with 10-point scale ranking used in CES EduPack Products, Materials and Processes Database**;
  - Apply Sensory Analysis tests to **evaluate other material trends**.

REFERENCES

[1] Ashby M. F., Johnson K. W. (2002) Materials and design: the art and science of material selection in product design, Butterworth-Heinemann, Oxford, UK.
[2] Faucheu J., Caroli A., Del Curto B., Delafosse D. (2015) Experimental setup for visual and tactile evaluation of materials and products through Napping® procedure. Proceedings of the 20th ICED2015 Conference. pp. 129-138.
[3] Figuerola M., Lai Q., Ashby M. F. (2016) The CES EduPack Products, Materials and Processes Database, White paper, Granta Design, Cambridge, UK.
[4] Karana E., Hekkert P., Kandachar P. (2009) Meanings of materials through sensorial properties and manufacturing processes. Materials and Design, Vol. 30, pp. 2778–2784.
[5] Piselli A., Simonato M., Del Curto B. (2016) Holistic Approach To Materials Selection In Professional Appliances Industry, Proceeding of the 14th International Design Conference - DESIGN 2016, Dubrovnik - Croatia, May 16 - 19, 2016, pp. 865-874.
[6] Stone H., Sidel J.L. (2004) Sensory Evaluation Practices, Academic Press, San Diego, CA.
[7] Wongsriruksa S., Howes P., Conreen M., Miodownik M. (2012). The use of physical property data to predict the touch perception of materials. Materials and Design, 42, 238–244.

9th International Materials Education Symposium
Clare College, Cambridge
April 6-7, 2017

Materials Education SYMPOSIA

POLITECNICO MILANO 1863
Electrolux
The Research Hub By ELECTROLUX PROFESSIONAL