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The perception of tactile feeling and corresponding textile attributes worldwide

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Abstract: The textile industry has been exploring sensory analysis as means to evaluate different products as a strategy to improve product comfort. The sensory analysis uses a set of attributes standardized for sensory evaluation: the lexicons. This paper compares three lexicons developed to assess the sensory comfort of textile fabrics, by researchers from France, Portugal and Brazil. Quantitative Descriptive Analysis was conducted for the development of these lexicons. The study showed that France and Portugal have thirteen attributes in common and seven attributes are common in France, Portugal and Brazil: Light- Heavy, Gross- Fine, Fresh- Hot, Soft, Plushy, Elasticity and Falling.

1. Introduction

Different types of fabrics are usually classified according to their physical characteristics that influence the quality of the textile products. Among several attributes of textile quality one of the properties that motivates the acceptability of the consumer and repeat their purchase, is comfort. The sensorial comfort is the result of a complex series of sensory stimuli between the fabric and human skin when wearing or touches a garment.

The textile comfort has been studied by instrumental and sensorial methods. The sensory comfort influences by the feeling that the clothing provides the user when in contact (mechanical or thermal) with the skin is the touch. Descriptive sensory analysis, much explored by the food and cosmetic industries, can characterize the attributes of different product types qualitatively as quantitatively [1,2]. Textile hand properties evaluate quantitatively through adaptations of methods of sensory analysis. This assessment is the result of descriptive psychological and physiological responses of individuals.

The sensory analysis is a technique where the sensations, when a material is touched, are quantified, and the human hand is the only instrument applied.

Therefore, the sensory analysis is a new and significant tool for general textile materials where the tactile feeling is of paramount importance for the consumer. The development of a global lexicons for tactile sensory analysis is an important tool for tactile evaluation of products. Before the evaluation process of the textile comfort is necessary to develop descriptive terminologies attributes that best define the characteristics of a product- Lexicons.

Among the methods of sensory analysis, researchers from France [3] and Portugal [4] adapted the Quantitative Descriptive Analysis (QDA) [5], with the purpose of quantifying the quality of touch in textiles. The researchers used this method to develop lexicons for the evaluation of the tactile sensorial attributes in textiles. Each national panel creates its own consumer-based (lexicon) word for the evaluations of a product type.



A Brazilian lexicon was developed by Nagamatsu et al. They used the same method as the France and Portuguese researchers, resulting in a lexicon of 11 attributes [6].

After the three lexicons were compared, seven terms revealed to be common among the three countries: three bipolar (light & heavy; thin & thick; Cold & warm) two describing the surface (soft; plush) and two describe the material (elasticity; falling) [7].

2. Materials and methods

The procedure of selection and identification of the descriptors was adapted from ISO 11035 [8]. A panel of Brazilian textile sensorial evaluators were invited to participate in the development of the Brazilian lexicon. They are 14 assessors (five men and nine women) from the city of Apucarana/ Brazil, with different personal taste, education level and expertise participated in this study.

20 samples with different textile structures and fiber composition, were cut into 20x20 centimeters pieces. Sensor Assessors touched the fabric samples behind a cabin and described the sensations when touching the samples without seeing them and using free vocabulary (Figure 1).



Figure 1. (a) Sensory evaluation cabin; (b) Touching one side of textile sample (c) Touching with both hands both sides

They generated 299 terms that were reduced in four steps, the first three by the panel during 3 meetings. First eliminating hedonic terms (128); Second reduction was rejecting descriptors with same meaning (122); Third reduction was combining singular terms (28); and in the fourth and last reduction, the panel quantified the perceived intensity of the attributes and these data were treated by means of statistical methods obtaining the last eleven attributes (figure 2).

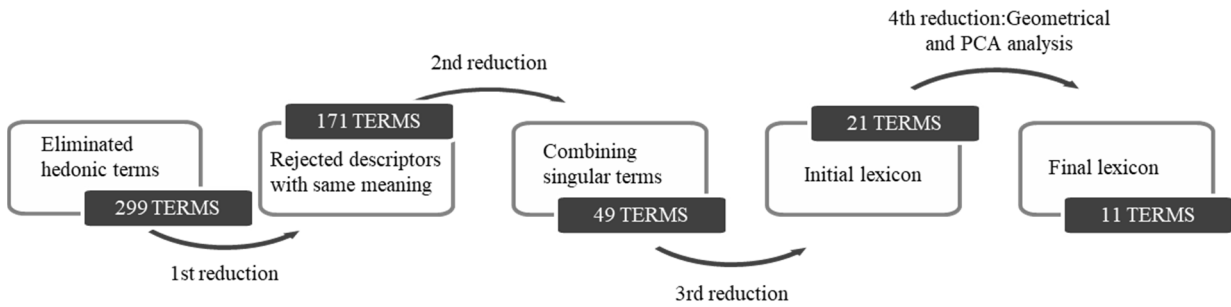


Figure 2. Process to reduce terms for the formation of Brazilian lexicon

For the development of the tactile sensory comfort lexicon for Brazilian textile products, four statistical models were applied. In Geometric Analysis it was possible to classify the order of perceived intensity. The interpretation of Correlation Analysis and the map of Principal Component Analysis - PCA (figure 3) allowed the identification of some differences and similarities between the attributes (positive correlation) as Itches and Rugged; Relief & Rough. Soft & Smooth and Fit and Flowing, as well as identifying the opposing attributes (negative correlation) that contributed to the classification of the bipolar terms: Light – Heavy; Thick – Thin; Fresh – Hot; Dry – Humid; Rough – Smooth.

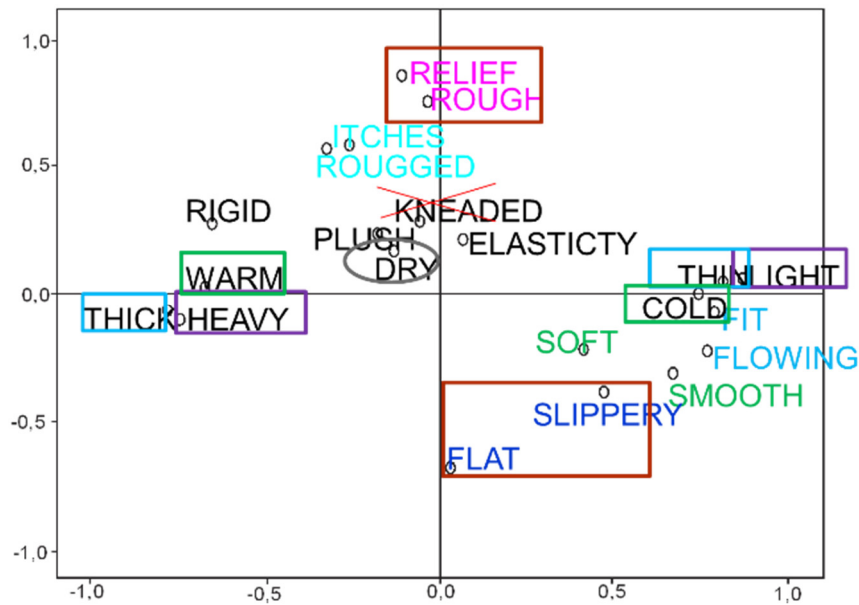


Figure 3. PCA of 21 attributes to evaluation sensory hand textile

The test-t was conducted to verify if there are significant differences between the arithmetic mean of the attributes. The attributes Kneaded obtained the p-value > 0,05. The attribute Kneaded was excluded because it does not contribute to differentiate the hand sensorial qualities between the textile samples. (table 1).

Table 1. Test-t of means against reference constant $p > 0,05$

VARIABLE	MEAN	N	STD. ERR	REFERENCE CONSTANT	T-VALUE	DF	P
LIGHT	2,268519	108	0,167757	0,00	13,52266	107	0,000000
HEAVY	1,583333	108	0,153490	0,00	10,31554	107	0,000000
PLUSHY	1,027778	108	0,147940	0,00	6,94727	107	0,000000
SMOOTH	4,425926	108	1,584813	0,00	2,79271	107	0,006193
ITCHES	2,018519	108	0,934232	0,00	2,16062	107	0,032956
SOFT	2,768519	108	0,929182	0,00	2,97952	107	0,003573
ELASTICITY	0,962963	108	0,148796	0,00	6,47171	107	0,000000
KNEADED	1,453704	108	0,934640	0,00	1,55536	107	0,122813
ROUGH	2,064815	108	0,141857	0,00	14,55560	107	0,000000
FLAT	1,333333	108	0,147084	0,00	9,06510	107	0,000000
THICK	2,768519	108	0,931600	0,00	2,97179	107	0,003657
THIN	1,527778	108	0,161369	0,00	9,46762	107	0,000000
FIT	2,259259	108	0,148472	0,00	15,21671	107	0,000000
COLD	1,564815	108	0,158564	0,00	9,86868	107	0,000000
WARM	2,259259	108	0,142525	0,00	15,85169	107	0,000000
RIGID	1,759259	108	0,155587	0,00	11,30722	107	0,000000
FLOWING	1,879630	108	0,162576	0,00	11,56156	107	0,000000
DRY	3,287037	108	0,924181	0,00	3,55670	107	0,000561
SLIPPERY	1,675926	108	0,157224	0,00	10,65948	107	0,000000
RUGGED	1,537037	108	0,157002	0,00	9,78991	107	0,000000
RELIEF	2,314815	108	0,177795	0,00	13,01959	107	0,000000

The analysis of the results of the application of the statistical models in the 21 attributes allowed decision making for a more precise formation of the Brazilian lexicon. The final list is composed of 11 most significant attributes (table 2).

The final list of Brazilian lexicons was composed with 11 descriptors. The panel also determined the definition, valuation techniques and references for each attribute. The lexicon in this study was made to assess the comfort of textile materials.

Table 2. Brazilian lexicons

BIPOLAR ATTRIBUTES	SURFACE ATTRIBUTES	MATERIAL ATTRIBUTES
LIGHT-HEAVY	SOFT	ELASTICITY
ROUGH - FLAT	PLUSHY	RIGID
THICK - THIN	RUGGED	FIT
FRESH - HOT		
DRY - HUMID		

3. Results and discussion

Comparison between consumers of the three countries/different continents was made and obtained a sensory profile, as introduced in table 3. The French and Portuguese lexicons have fourteen terms and Brazilians developed eleven terms.

The study showed that France and Portugal have thirteen attributes in common and seven attributes are common in France, Portugal and Brazil: Light- Heavy, Gross- Fine, Fresh- Hot, Soft, Plushy, Elasticity and Falling.

Table 3. Lexicons French, Portuguese and Brazilian

	FRANCE	PORTUGAL	BRAZIL
BIPOLAR ATRIBUTES	Light- Heavy	Light- Heavy	Light- Heavy
	Thin- Thick	Thin- Thick	Gross- Fine
	Cold- Warm	Cold- Warm	Fresh- Hot
	Supple- Rigid	Supple- Rigid	
		Sleek – Rugoss	Rough- Flat
		Rough – Smooth	
			Dry- Humid
SURFACE ATRIBUTES	Soft	Fluffy	Soft
	Pilous	Pilous	Plushy
	Granulous	Granulous	
	Sticky	Sticky	
	Slippery	Slippery	
	Greasy		
	Grooved		Rugged
MATERIALS ATRIBUTES	Elastic	Elastic	Elasticity
	Falling	Falling	Falling
	Responsive	Shape Recovery	
	Crumple-Like	Crumple	
			Rigid

The rigid and supple bipolar attribute were not considered by Brazilians. Brazilians grouped Portuguese bipolar terms Sleek - Rough and Smooth Rough differently.

Only the French introduced terms such as Greasy and Grooved and the Brazilians presented Dry - Humid.

Although these three lexicons were developed for textile hand assessment of textile fabrics, Nagamatsu et al. [9] adapted three attributes to sports cap wear trial evaluation: tridimensional products (Light-Heavy; Gross-Fine; Fresh-Hot). The authors compared the results of the Fresh-Hot attribute between objective evaluation with wear trial and objective evaluation with thermal/humid sensors.

4. Conclusion

In this work, the three developed lexicons, by France, Portuguese and Brazilian panels, were developed in different countries and compared in this research. We can consider, that the seven common attributes are the most mentioned among panelists and offer higher improvement in the development of innovative clothing, resulting in greater comfort to the consumer.

Furthermore, we can consider these seven attributes form the lexicon of tactile comfort and they can be exploited worldwide for hand textile assessment.

Key words: Tactile Feeling, Thermal comfort, Textile Lexicon, Attributes

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