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Ergonomic Analysis of Visual and Tactile Information of Materials Used in the Manufacture of Toys

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Abstract

Products intended specifically for children began to be developed in the second half of the seventeenth century, driven by a change in the adult's view of the role of children in society. Over time it was noted that children were more vulnerable to the risk that the products could offer, and there were rules that seek to promote greater protection to those users. This was decisive in how the industry would follow with their developments.

Among the materials most used in toys and other children's products are wood, polymers (polyethylene, polypropylene and abs, EVA, nylon) and fibers (cotton, polyester, cardboard), as a rule, non-toxic and non-flammable. With technological advances is common to find products that mask their characteristics seeking to better meet consumer expectations. The texture, surface, and color prints directly influence the user of the goods, as well as those characteristics in material that has originally are directly linked to the comfort in handling. Thus classify materials in two stages: in its raw form (or with minimal interventions) and how is presented in toys. We seek to evaluate how their visual impressions differ from tactile sensations they provide, and what the printed products in those intentions.

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1. Introduction

The materials selection is an important stage in the development of products, and meet the different issues involved in the design process. The texture, the surface, and the colors directly influence the impressions that you have the products, and these characteristics in materials that have them originally are directly linked to the comfort in handling. According Krippendorff [1] "the human being does not answer the physical qualities of things but what they mean to him." Thus classify materials in two stages: in its raw form (or with minimal interventions) and how is

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presented in toys. We seek to evaluate how their visual impressions differ from tactile sensations they provide, and what the intentions embedded in those products.

The design, as well as other areas has been using this ergonomics with a view to finding solutions to their problems projective. This selection is made through the processes, costs and results to be obtained, but it can not be forgotten that contact with the user is relevant in use may influence their function or consumer choices. This paper seeks a relationship between the concept of visual and tactile ergonomics and materials used in toys, in search of an overview to assist new projects in the area.

2. Production for children

Products specifically designed for children began to be produced in the second half of the seventeenth century, driven by a change in the adult's view of the role of children in society [2]. These initially were very similar to those intended for adults, distinguishing only by the proportions and thematic applied [3].

The toys were made of iron, wood and earthenware so the products represented in miniature. Over time it was noted that children were more vulnerable to the risk that the products could offer, and there were rules that seek to promote greater protection to those users. The first standards that specifically address on the safety on toys are of the 80s. Among the first regulations in the world we can quote "JS 90: 1983 Jamaican Standard Specification for Safety of toys and toys", "Argentine Institute of Rationalization Materials 3583 - Part 1: 1986 Seguridad de los playthings, MARKED, labeled y Packaging "and the international standard" ISO 8098: 1989 Cycles - Safety requirements for bicycles for children. " In Brazil since 1988 certification INMETRO became compulsory. The tests to which the products are subjected aim to ensure user integrity during play or a possible breakdown of the product. This was decisive in how the industry would follow with their developments.

Among the most used materials in the manufacture of children's toys and other products are wood, polymers (polyethylene, polypropylene and ABS, EVA, nylon) and fibers (cotton, polyester, cardboard). With technological advances is common to find products that mask their characteristics seeking to better meet consumer expectations. Van der Linden [4], in their studies highlighted how the visual information of comfort influence in procuring products as work chairs.

3. Materials and representing

The materials have symbolic meanings that are allied to its origin, the sensations and functions they perform in the materials in which they are applied. According to Van der Linden [4] the 'Ideological Pleasure' provided by the product it feel bound to their own values according to the relationship of the aesthetic aspects of the product with your visual repertoire or values that enter.

Natural materials such as wood, leather and the fibers are usually linked to comfort. In experiments with Van Der Linden of work chairs [4], the upholstered in leather were indicated as the most comfortable just based on the user's observation. The timber provides a comfortable tactile sensation directly related to the degree of elasticity and with its heat to a lesser degree [5].

Metals, in turn, are associated with technological products and products with precise dimensions. The material is associated with phases of technological evolution, since the "age of metals." The rapid development of the methods of refining and iron work propitiated that from the nineteenth century industrial machinery were no longer made of wood to be made of metal and there was a rise of large-scale production of metal objects commonly used.

Plastics are generally associated with popular products, practical, low cost and durability. The development of this material led to the large-scale manufacture of products with high strength made with lightweight materials with smooth finish, which do not require treatment or painting, thin-walled, creating easily substitutable products. Thin and light pieces can pass the feeling of an ephemeral work, provisional, subject to time shares. Already massive pieces, large and sections, refer to a condition of robustness and durability [6].

4. Toys materials

The materials adopted in toy According to ABNT [7] must be nontoxic, and can not generate by breakage points or sharp parts. According to the Standard are sealed materials and components produced with metallic mercury, asbestos, acids and bases, ammonium nitrate and lithium hydroxide. For products intended for children under 3 years must meet the limit of phthalates in plastics additives according to local regulations. The most commonly found materials are wood, plastic, vinyl, textile fibers, especially the plush, and the cardboard. The purposes of the toys are generally associated with a specific material, not only by its physical characteristics, but also by the production characteristics and production costs.

4.1 Wood

One of the first materials used in toys, wood is still found, especially in toys rated by manufacturers as educational. Its use is still defended by a large part of educators, as the supporters of Waldorf, being natural and manufactured materials [8]. The material requires treatment and pigmentation at the end of the manufacturing process, and its associated increased risk of toxicity ink can be used and the possibility of breaking into sharp pieces figure 1.

Fig. 1 - Wooden railway with locomotive and wagons - Melissa and Doug

4.2 Plastics

Plastic revolutionized the mass production of consumer goods, and it was no different with toys. Developed mostly from oil has several variations, with different mechanical characteristics such as polyethylene, polypropylene and ABS. The material is found small components to complete products and the material is easier cleaning Figure 2.

Fig. 2 - Shield launching Darts Captain America - Hasbro.

4.3 Vinyl

It is a polymer using ethylene and chlorine in its composition and not oil as plastics. Although still widely used in body dolls and toys for babies as rattles and teethers in Brazil is a very controversial material, because to acquire Macies they present, these materials are with additives of DEHP, phthalate-based plasticizer substance and, according to some researchers, toxic [9]. The use of phthalate is banned in countries like Argentina and European countries, Figure 3.

Fig. 3 - Peppa Pig doll made of vinyl - Star

4.4 textile fibers

Another material used since the first toys found in history, the fabric remains one of the materials most commonly found, especially in the first age toys and dolls. The fibers currently used as filler should be non-toxic, and the material can facilitate the proliferation of mites, causing allergies, so it requires constant care with cleaning, figure 4.

Fig. 4 - Fabric doll Emilia - BBRA

4.4.1 Soft

It is a fabric made of wool, silk, cotton or synthetic fibers and other textiles, whose main characteristic has a smooth side and a shaggy. Generally used to represent animal skin, because their tactile characteristics. The risks are the same as of other textile fibers Figure 5.

Fig. 5 - Pluto manufactured Excited with plush - Multikids

4.5 Cardboard

Cardboard is mainly used in games such as board games and puzzles. In many cases, the packaging itself serves as a component of the toy. They are usually printed in graphic and lead laminate finish that provides a lightweight waterproof, Figure 6.

Fig. 6 - Cardboard Puzzle Britto's Garden 5000 parts - Grow

4.6 Alloys

Thumbnails of vehicles, airplanes and other toys that mimic iron were manufactured for many years of brass. Today the most used is the Zamac alloy, a zinc alloy composed of four basic components: Aluminum, Copper, Magnesium and Zinc SHG. Due to its physical properties, mechanical and easy coating capacity by electrodeposition. Its low melting point (about 400 °) allows a greater durability of the mold, allowing greater production of cast parts in series, Figure 7.

Fig. 7 - Shopping Cart Hot Wheels - Classic - 68 Olds 442 - Mattel

5. Characteristics x Impressions

According to Schmid [10] there are two basic types of texture: tactile, which is felt through direct contact with certain surface and the visual, which is perceived by the eyes. We seek to classify the material according to its visual texture (table 1), and its specific heat to the mechanical characteristics and modulus (table 2), which are relevant for tactile identification of the material. The natural finish (N) was defined as the material resulting in the simplest possible transformation without the use of arrays or surface treatment. Was marked "X" visual impressions in the material adopts some products through processing.

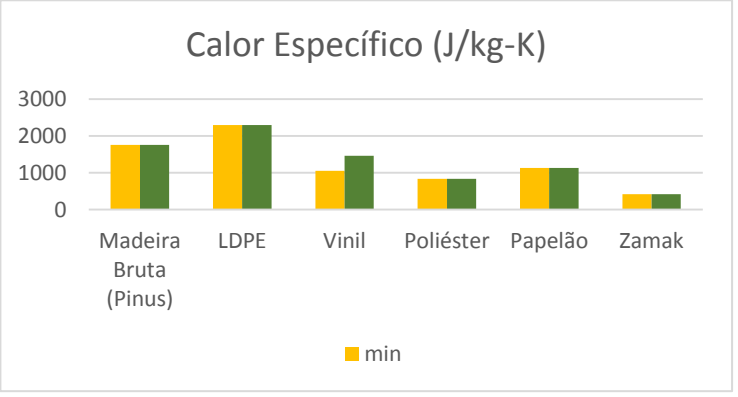
Table 1 - Visual Aspects of materials

MATERIALS	SURFACE			
	MATT	SMOOTH	WRINKLY	FUZZY
HARDWOOD (PINUS)	X	X	N	
LDPE	X	N	X	X
VINYL	X	N	X	X
POLYESTER	N	X	X	N
CARDBOARD	N	X	X	
ZINC	N	X		

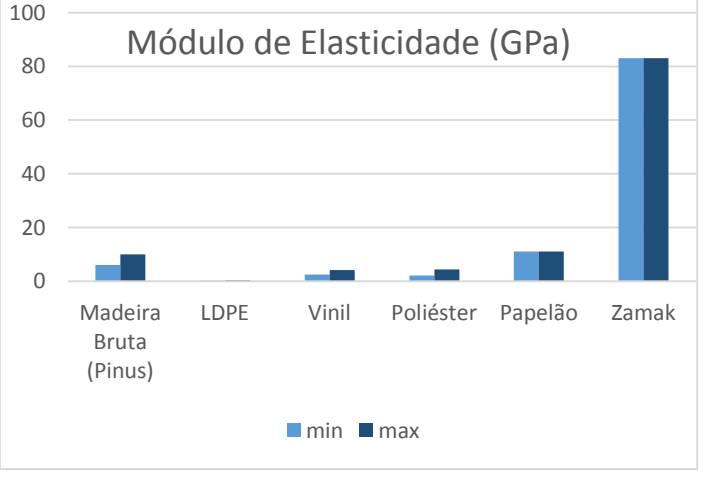
With the data collected was possible to evaluate what materials had higher similarity according to these aspects (table 03). In cases where both numbers indicate proximity of the same secondary material, we can assume that this would represent the best replacement for that.

Table 2 - Mechanical properties of materials

MATERIALS	SPECIFIC HEAT (J / KG-K)		MODULUS OF ELASTICITY (GPA)	
	MIN	MAX	MIN	MAX
HARDWOOD (PINUS)	1757	1757	6	10
LDPE	2300	2300	0,172	0,282
VINYL	1050	1460	2,41	4,14
POLYESTER	840	840	2,06	4,41
CARDBOARD	1130	1130	11	11
ZINC	418	418	83	83



Graph 01 - Specific Heat



Graph 02 - Module Elasticity

Table 03 - Selection by proximity similar characteristics

MATERIAIS		SPECIFIC HEAT	MODULUS OF ELASTICITY
	HARDWOOD (PINUS)	VINYL	CARDBOARD
	LDPE	HARDWOOD (PINUS)	POLYESTER
	VINYL	CARDBOARD	POLYESTER
	POLYESTER	VINYL	VINYL
	CARDBOARD	VINYL	HARDWOOD (PINUS)
	ZINC	POLYESTER	CARDBOARD

6. Concluding Remarks

It can be seen through this analysis as the material may be contrasted with the intention suggested by your application. Example of polyethylene letters may resemble cardboard, but has very distinctive tactile characteristics, which may influence the relationship between the user and the object. From these data we can apply practical testing to confirm the differentiation of materials by users and how these differences influence the impressions that those are the subjects of research.

These can help new projects and better target material selection by the designer for a project directed to the specific type of user. Understand the influence of texture, colors and images reduce the risks involved in an understanding or wrong feeling. Understand what type of material is being used and why this is a better option may not be a choice only turned to the market, on economic issues, but rather focus on who will use this product.

Working with products aimed at children require great care and understanding of how these use these increasingly electronic and complex objects where some simulate realism and interaction. The materials employed there must offer security and provide a pleasant feeling, where the child feel close and adults to feel peaceful in let them play without fear that an accident occurred. All these factors must be considered by the designer before the product go to the market, in order to not allow a wrong and aggressive interaction between the product and the end user.

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