

Investigating and classifying visual references used in product design

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Abstract: Because of improvements in technology and changes in the social environment, the role of product design is not just to provide the client/user with a functional product. It is important that the designer provides a new value for existing products. Sources of inspiration play an important role in the design process, both in defining the context for designs and in informing the creation of individual design [1].

The initial study of this research is to truly understand the role visual references currently play within the design process. Therefore, the research presented in this paper seeks to advance our understanding of how visual material can facilitate design. Firstly, it will focus on how designers use visual material within the design process, especially in order to know what sort of visual material it is. Next it will attempt to explain how the designers interpret visual material in order to understand what sort of thought process they have when they describe visual references. A series of interviews and a workshop carried out as part of this research have identified that product images form the majority of visual references used by designers as they provide more context than others images. The research also suggests the initial image context should be divided into tangible and conceptual subjects. Visual material is also used as a communication tool with others designers and clients.

The aim of this study is to develop a classification of image types and reference keywords to construct an electronic image database for professional use in product design.

Key words: *Product design, Visual language, Visual references, Classification*

1. Introduction

In this new century, designers not only work on the production of a product, but their assessment also requires them to focus on enhancing the value of the product for their client. A lot of investigation has taken place with regards to the design process, in order to enhance and develop design work. Within the design process there are a number of reasons that would affect a design outcome. However, the end product does not just depend on the design model. It is also influenced by a designer's capability, the right design tool - theory, methods and processes as well as experience and knowledge of industry. A designer's knowledge is generated and accumulated through action. Designers use knowledge to create and evaluate their work, this serves a continuous aid, helping to build on their existing knowledge.

Austen [2] has argued that within a library to support the design process there might be books, periodical and

comprehensive coverage of information on existing products, and also a large collection of product samples and an extensive referral service to sources of expertise in industry and research organisations. According to Formosa [3], an insufficient flow of information leads to inadequately designed products and he believes that information could enhance the design process; in the proper environment it will feed creativity. Designers frequently search for and use information to help them to construct new knowledge related to the design topic, simultaneously searching for new information that will help to determine design constraints and produce a satisfactory design. [4]

There have been several investigations into the method of gathering appropriate resources for designers in order to improve creativity and the design solution. Most research focuses on providing user's with information to fulfilling a need. Design today is being recognised as a critical factor within industry and marketplace. Therefore, within the design process more information is needed than just ergonomics. A product databank based on today's computer technology can give designers such information easily and quickly. Most classification of products has been done by type, as in the Design Index (Appendix A). However, it is argued here that consideration should be given to categorisation on other functional bases, such as; controls, colour, material, shape, texture.

As shown in 'Design for ease of use: Product semantics and Design Education' [5], there was a significant result when using product semantics to assist in the design process. This research used 14 key words to describe products. Although those key words were mostly concerned with products functions, such as handles and buttons, this is a precedent for developing a database with descriptive keywords for visual reference.

According to Baxter [6], before the design process was put into practice, visual references were taken as a designers' approach to explore the concept. Mono [7], commented that a designer should aim at understanding product language better to be able to improve his design. If that is the case, then a visual reference based on a classification; by product language would provide designers with more inspirations.

This research present here is to show how visual references could be classified by the requirement within the design process.

2. Method

A serials of interviews and a workshop were carried out in order to understand the role visual references play within the design process and gain a perspective on dividing images into categories. The aim is to develop a dictionary of key descriptive words and construct an electronic image database for the use by product design professionals.

2.1 The Survey

The survey was based on an investigation of how product designers discuss and categorise visual design sources. It also collected information about the role visual material currently plays in the design process within practical design territory.

Firstly, it focused on how designers use visual material within the design process, especially in order to know what sort of visual material this is. The research then asked how the designers interpret the visual material in order to understand and describe visual references. Furthermore, there was a section that focuses on their understanding of product semantics. According to the literature review, product semantics is a theory about the representation of language of products from the 1980s. The survey aims to observe whether it does or does not influences the way designers interpret the visual references.

Table 1. The questionnaire for the interviews

The status of visual references within design process	
1	When you are given a design briefing how would you describe the design process from start to finish?
2	What sort of resources do you use at different stages in the design process?
3	What kind of information you look for within the resources you use?
4	Are there any specific resources you use to help stimulate ideas?
5	Do you use visual references and if so at which point in the process?
6	When you have all the design requirements, do you have a mental image in mind and if so can you describe them?
7	Within the design process, at which points and with who do you discuss your ideas with? And what is the emphasis within the discussion?
How they store and access these images	
8	Do you have a personal collection of visual material you use for inspiration and if so what sort of images are they? How do you store them? How do you classify them?
The status of product semantics in practical field	
9	What is your understanding of product semantics? Do you use product semantics within the design process? Yes – can you describe how? No – why do you not use them?
The word they use in describing visual feature.	
10	Questions about the images: What is your feeling and reaction?
11	Questions of the products: How would you describe the visual quality and property of this product?

There are in total 11 questions (Table 1). The strategy for understanding the words designers use in the describing visual features was to show designers some selected products and images. There was no specific principle for selecting the products

and images, because the designers, according to the literature research, access varied products and images in order to gain experiences and knowledge. The products selected, therefore, were easy to carry to the interview and the images were selected by randomly picking the



Fig.1 Products and Images of interview

images from the book of *Notable Product Design* and the image providers (Digital Vision) (Fig.1). The survey was carried out by interviewing 17 designers based in London. Their professional experiences range from 3 years to 35 years.

2.2 The Workshop

In order to test the results from the survey, a workshop was planned. The purpose of the workshop was also to improve the understanding of what sort of information an image could deliver. Nine MA Industrial Design students from Central Saint Martins' College of Art and Design participated in this workshop.

They were asked to classify images of product in various ways. There were 4 different packs of images, which were presented in 7x7 cm. The packs had total 96 images comprised of 48 PRODUCTS and 48 NON -PRODUCT images. In each pack 16 PRODUCT and 16 NON-PRODUCT images were the same (the definition of

PRODUCT images and NON-PRODUCT images is given in the survey result described later). There were 5 students who were asked to classify the images in PRODUCT and NON-PRODUCT groups and 4 other students classified 96 images within one group.

3. Results and Discussions

3.1 The survey

The aim of the survey was to understand how designers categorise visual references.

3.1.1 The status of visual references within design process

There are many theoretical models of the design process to assist its effectiveness. However, when practised professionally the models will be adjusted to suit the time, area, and people. According to the responses, they all reflected that generally the design process used would differ depending on the project or clients. The results indicated that after the front-end phase there is not a big difference in activities within the design process of sketching, technical drawing and prototyping. The main issues of the front-end phase are to try and identify the problem and give it a solution, but the ways of doing this vary greatly.

How designers start the design project and what they focus on is often completely different. Some of them focus on identifying the brand value and product value. Others focus on consumer group research in order to fulfil the consumers' need.

The resources they used within the design process include magazines, books, libraries, the Internet, designers, engineers, consumers, manufactures, exhibitions, specialists, and first hand experience, not forgetting sketching, rendering, and modelling.

The information needed includes: technical, social, trade, user-product relations, competitive products, understanding of the manufacturing process; and the things that can describe value, such as consumer behaviour, styling trends, lifestyle, and technology.

According to the responses, designers use visual references in two way, one is for mood boards used to research the kind of things which enhance designers' understanding and visualisation; the other is for communicating with clients because images with words are a useful tool to present intangible design concepts.

All the responses pointed to the need for visual references which include what the environment of the product will be, where the design may go, the nature of the product, the particular audiences, size, and shape. Designers all stated that in the end the outcome visual concept will change but the main theme is still the same.

They all agreed that discussion happened all the way through the project, with your team, boss, client, manufacturer; also it could be happening with the users or friends.

Consequently, visual references are used many times within the design process, especially within the front-end phase. Mainly, designers use visual references in order to

- Communicate with client
- Study about the consumers
- Assist to express the themes of the project
- Understand the related environments
- Look for functional solutions.

These possibilities are all used to enhance the designers' visualisation of the product's design.

3.12 How designers store and access these images

According to all the responses, designers did not actually have a organised visual material collection, what they had was mainly accumulated from magazines or books, or the visual material they had from previous projects. If the materials have been used for previous project, then they are stored digitally and generally classified by project title or client.

The result indicated that when the companies interviewed they need images to assist their research, they would start with magazines, books or nowadays using the Internet. With books and magazines, they have two ways in which to do it, one is that they go through all the magazines and books quickly to find something they need or that they would use their memory to look for a specific image that they have seen before. They implied that this activity wastes time, but sometimes it could come up with new ideas when the image catches the designers eyes while they go through the magazines. Using the Internet, a technology benefit, designers use a search engine, such as Google, or image bank website to search for images by inputting some keywords or searching in the category provided by the website. However, there are always problems while searching on the Internet. Firstly, it wastes time because if you search by search engine, it could have thousands of results. Secondly, they indicated that the categories of image banks are more suitable for advertisement or graphic design than product design.

3.13 The status of product semantics in practice

Because of its ability to assist interpreting products, the survey tried to discover what designers understanding of product semantics is, and, furthermore, it tried to observe if this theory influences them when they are designing or interpreting a product or an image. The responses include:

- “In terms of visual, it means what products try to do”
- “Product Semantics is a visual language”
- “Product Semantics is the language of product”
- “Product Semantics relates to semiotics; object communicate to visual code”
- “The use of visual devices to give people a way of visually reading”
- “Product Semantics is the meaning of products”
- “Product Semantics is a link to a culture, styling and fictional association”

However, none of them used this theory within the design process specifically and some of them were even trying to avoid it; however, they all stated that they probably use it subconsciously as it is a natural process to come out within design without knowing it. When they do use it, it is normally to deal with function. The people who were educated before the 1980s are not particularly familiar with product semantics or they do not have an idea of what the theory is. They recognize that it did not affect their works. The result also relates to the previous study by Brown [8] in which he indicated:

In all 12 out of the 34 designers polled (35.3%) acknowledged regular use of semantic thinking in the design of products. However, 17 out of the 34 (50%) designers polled in the field study indicated no regular or conscious use of product semantics in the design process.

In conclusion, most designers have knowledge about product semantics, even if their definitions vary. However, they see product semantics as a theory to explain what they do in practice and which happens mostly subconsciously. When they use it, it is often to express functionality.

3.14 The words designers use in describing visual features

The survey collected the words or language that the designers used to express information about images (see Fig.1). There was much commonality in responses when they talked about physical quality. The following points were noted:

1. The responses they gave were related to their type of work. Those working mainly in furniture design given more comment on the furniture images.
2. Age is an influence. The household picture brought back past memories for two interviewees as they were from their lifetime.
3. Although asked to talk about product quality, the *LAMY* pens indicated that where the brand is well know, brand image is of more interest.
4. Their age and design area influence their view, especially when they see the MD player, older designers were less interested in the product than young designers, therefore they did not comment much about the product.
5. The cable tidy is an interesting object. If the designers had seen the object before, their appreciation was very strong. However, even if the designer had not seen it before, they still felt it was a very interesting object.

According to all the responses, the language they used to discuss the images and/or products could be synthesised into:

- 1) The object + adjective
This product is ergonomic design; the handle is very ergonomic.
It is **functional**. It is designed by **geometrical form**.
- 2) The object + sense + adjective
This product **looks fun**.
It **looks heavy**. It tries to **show** quality.
It **looks cheap**. The material **looks warm**.
- 3) Style
This is **1980's design**.
This is **Bauhaus Style**. It reminds me **Memphis**.
- 4) The function of product
It is **portable**. It seems you can **open it**. It is comfortable to **hold**.
- 5) A description/interpretation.
It is **houseware**. It is **furniture**.
- 6) Cause and result
It is a good/bad design, **because** the sign is too small.
The colour is very strong **so** it looks very modern.

3.15 Conclusion of the survey

This indicates that designers use a lot of adjectives to describe the representation of products. They could be divided into rational responses or emotional responses, according to the attributes of the product.

All the responses are varied, however, there are some generic subjects which can be picked out. The words that designers used to describe the objects could be divided into several subjects:

Colour	Material	Texture/finish
Sound	Time/age	Price
Consumers	Environment	Weight
Function	Lifestyle	Trend

The aims of this survey were to understand the role visual references play within the design process, and observe what kind of subjects and keywords are used by designers when searching for visual references. The results indicated that designers' thinking can be influenced by their immediate surroundings. They could be influenced by any visual material that could be from magazines, books, the Internet and photographs; usually focusing on a specific subject or detail. Basically, the contents of visual references could be divided into:

1) PRODUCT images

This means the image contains an individual product or collection of products. It can also be only a detail of product or an image with specific information such as material, texture or function.

2) NON-PRODUCT images

The images in this category covered a very wide range of subject matter. Designers give the images specific definitions; using them to present a subject or theme.

In conclusion, designers use visual references in order to communicate with clients, study about the consumers, understand the related environments and assist them to express the themes of the project. They are all concerned with communicating, interpretation and understanding. The results suggests that the study of product semantics still should be involved in this investigation, as designers are all aware of it and generally confirm that it used within their design work.

3.2 The Workshop

3.21 Product Images

There were 5 students participated in classifying PRODUCT and NON-PRODUCT images separately. The categories of classifying PRODUCT images show at Table 3. The result shows:

- Even though the participants were told not to classify the PRODUCT image by the type of products and their physical properties, the categories most used were those describing the intention of the product, such as "Vehicle", "Lamps", "Home appliance" etc; this indicates that general product categories are still the main and easy way of classifying images.
- They used "vehicle" or "transport" and "wheels" to describe similar content, in the same way as "Lamps" and "lighting". Although, the definition of these words might have similarities; the imagery of these words could be very different. It also brings out the subject of classification of words in this research, because this research focuses on classifying product by a new approach not by the name of the type of product. However, "wheels" and "lighting" are not specifically product types but they also could be definitions of products.

Table 2. Result of classifying PRODUCT images (the table below shows the categories made by each participant (A-E))

A	B	C	D	E
High tech small devices (use with hand)	Fast moving lines	Domestic appliance	Cute	Wheels
Furniture	Egg holders	Furniture	Structural	Life saving
Vehicle	Ashtrays	Transport	Simple	Sexy home furnishing
Glass, ceramic, container	Mechanical engines	Electronic	Difficult	Uncomfortable furnishing
Lamps	Watches, clocks	Lighting	Old	Gadgets
Office	Reflections	Pens	Stylish	Boxes
Old forms for kitchen use	Colours mixing	Luggage	Masculine	Kitchen
Modern forms for kitchen use	Strings		Feminine/organic	Lamps

- Although, most classifications were by type of product; the participants also used the descriptions of emotional responses to emphasise the representation of products, such as “old”, “modern”, “cute” and “sexy” etc.
- All the categories created by the participants could be reduced into certain subjects:
 - 1) Product type
 - 2) Product form
 - 3) Style appearance
 - 4) Product type + style appearance
 - 5) Material appearance
 - 6) Colour appearance
 - 7) Product type + sensation
 - 8) Product form + sensation
 - 9) Function

Further analysis of the results where participants were classifying the same collection of images shows that the

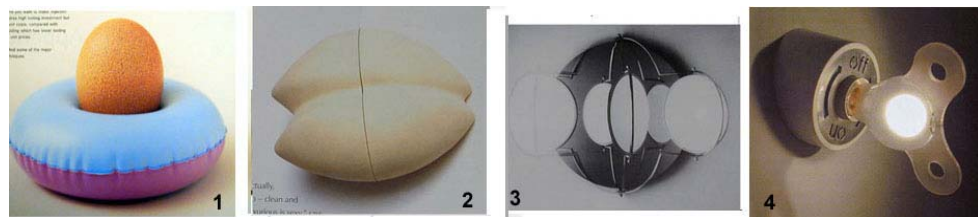


Fig. 2 The excluded images

participants only classified the images by the appearance and characteristic when the image was not of an easily identified product (Fig.2). For example, one of the classifications of image 2 in Fig.2 was into a “feminine/organic” category; image 4 in Fig.2 was classified into “cute” and one participant gave image 3 a category of “reflections”.

Only one participant (B) classified the images by the context and another gave very different categories. His/her categories are neither the real product types nor the context of the images. They were named by the function of products, appearance of products, and the interaction of the products.

From the classification of the same PRODUCT images, the result indicates that:

When the category named the type of products, the images were exactly the same. And one participant was sub classified a category by perceived qualities (Fig.3). (The grid represents the number of images; the alphabet represents the participants.)

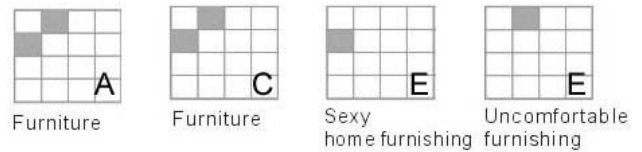


Fig.3 Classification result

3.22 Non-product Images

The result of 5 participants' classifications for NON-PRODUCT images indicate:

- Most categories were titled by the content of the images, such as “cartoon”, “music”, “architecture” and “home” etc.
- There were only a few categories which were concerned with the emotions; such as “boring”, “fun”, “happy” and “lonely” etc.
- Unexpected categories were the product types: “transport” and “furniture” in the NON-PRODUCT section.
- The variability of the NON-PRODUCT categories was wider than PRODUCT images; and there were also more categories (54) than PRODUCT images (42).
- All the categories created by the participants could be reduced into certain subjects
 - 1) Emotion/Sensation
 - 2) Space
 - 3) People
 - 4) Object
 - 5) Activities
 - 6) Art & design
 - 7) Theme (e.g. nature, refresh)

Fig.4 shows that when they have the same categories, the images put into them are mostly the same but the Fig.5 shows that the same image could be put into different categories. It indicated that classifying images into named categories would more often give the same result than asking people to name a category for images.

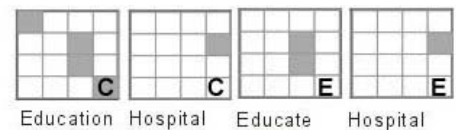


Fig.4 Classified result

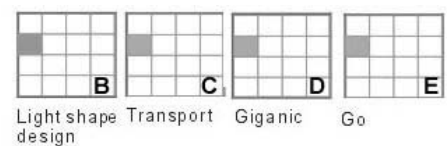


Fig.5 Classified result

3.23 Product and Non-product Images

Table 3. Result of classifying all the images together (the table below shows the categories made by each participant (a-d))

a	b	c	d
Novelty	Nice for eyes	Highly designed life/contemporary	Visuals that triggered emotion thoughts
Functional and fun	Freedom to see	Annoying/irritating object	Poetic functional
Stylish	Plastics and industrial design	Wealth bourgeois life	Just poetic
Action	True love	Institution	Non-emotional products
Japanese style	Design for evolution	Imitation	Male-world
Organic	World of design	Leisure + pleasure	Functional & interesting
Child-like	Basic	Craving of speeds	Sweet, giving, and thoughtful through design
Boring	Wood and boxes	Early adopters	Overworked design/ 90's style
Emotion	Art	Sustain ability	Nature
Destructive	Despair	Classical context on form	False reality
Space	Bad influence	Cultural difference	Created emotion
Simple	Child-ness		Uninteresting images
Masculine			Perception of time and place
Strange			Repetition
			Practical

The 4 participants in this section had to classify PRODUCT and NON-PRODUCT images together. The names of categories in this section are more about the context of images. Most of categories included PRODUCT and NON-PRODUCT images. This indicates that PRODUCT images also could be categorized by the context, but the initial way of classifying them is by their physical property.

It also indicates when images are classified by the context, in the same sort of categories; such as “child-like” and “child-ness”, the images could be varied. Comparing with the NON-PRODUCT section, it shows that if the category name is a tangible description the difference of the contained images was less.

3.24 The conclusion

- The aims of this workshop were achieved in that the main categories as defended by the result of interview; such as colour, place, emotion etc. are appropriate. New subjects that might be caused by the difference in the backgrounds and experiences of the participants were added but this is to be expected.
- The words use to describe the same objects or subjects could be very different, nevertheless, there is a certain relationship between these words; for example sweet, giving and thoughtful share the same category.

4. Conclusions

According to the survey, to understand the sources of inspiration, visual references could be analysed from four different aspects (Fig.6): function, content, information and subject.

- Function of images: reasons for using an image, which have be described in 3.11.
- Content of images: what present inside the image, there are two main groups: PRODUCT and NON-PRODUCT.
- Information of images: the information for which the image has been recorded, see 3.15.

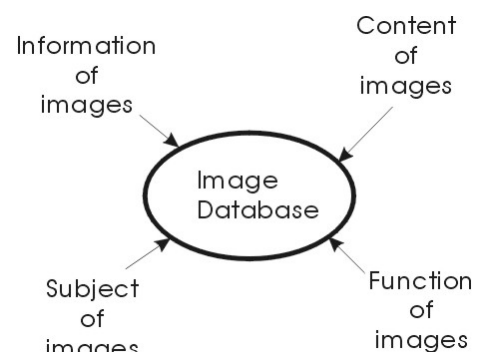


Fig.6 4 aspects of developing image database

- Subject of images: the interpretation of the information in the images, for example, colour and material are tangible subjects, and characteristic and value are conceptual subjects.

The content of images allows the visual materials used by designers to be physically divided into PRODUCT images and NON-PRODUCT images. Then, the subject matter of interpreted information may be divided into TANGIBLE and CONCEPTUAL (Fig.7).

The information about the images will be used as main categories to develop relative descriptive words in order to construct an image database for product design professional use.

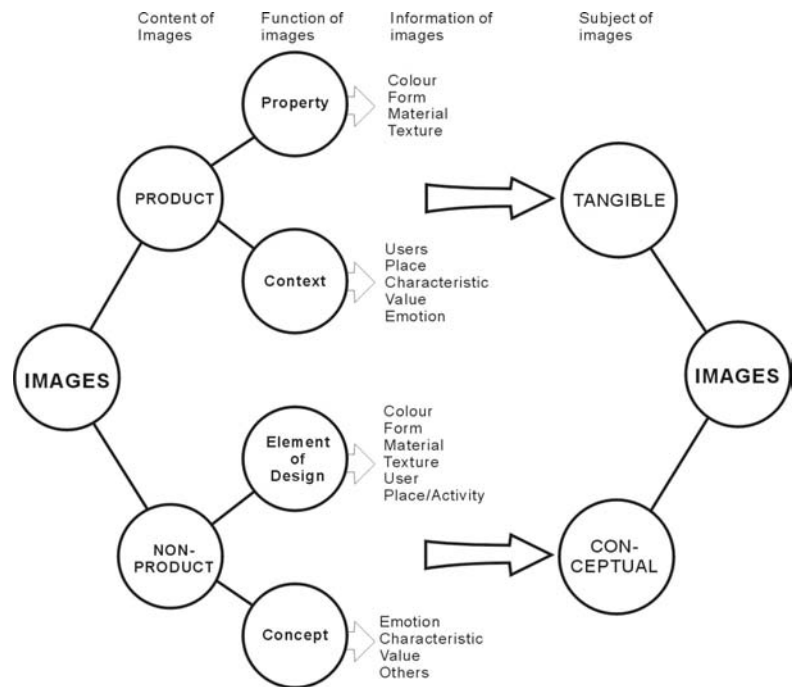


Fig 7. Structure of image classification

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Appendix A

Product indexing:

For a number of years the Design Council maintained the Design Index, a record of some 7,000 'well designed' British consumer goods. The Index, now at Brighton University, comprises a photographic record of selected products, together with their specifications, costs, and the name of the designer and manufacturer.