The artefact as visible materialization: visual perception informing object analysis

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Introduction

This project stands on two theoretical pillars, one refers to theories and concepts relating to innovation and differentiation, and the other deals with visual perception. Marketing and psychology blend in order to look at how visual perception can enhance our understanding of product differentiation.

The merger of design and psychology is not a new one, but usually what is seen are investigations of psychological desires, feelings, preferences, the soft, subjective side of humans. What is proposed here is the use of humans as tools, visual perception as an objective ruler, scaling visible design differences.

Initially, the paper is informed by literature from all three paradigms. The marketing perspective stresses the need to see products from the viewpoint of the consumer. Innovation and product differentiation are discussed, showing that incremental and style changes are frequently used in order to turn over sales. Design is almost not discussed in the marketing literature and although it is acknowledged that consumers have preferences in terms of product function, other deliverables such as changes in style, are largely absent.

Before being a consumer, this human being is first an observer, an instrument of visualization, who can perceive novelty and spot design differences with greater or lesser ease. Subjectivity involved in issues of perception, be that perception of newness or of visible differences, leads to enquiry in the psychology paradigm. Studies of visual perception have traditionally been applied to two-dimensional images and other investigations and experimentation have extensively studied form features in isolation, testing how colour, shape, contour and other design elements are perceived. These elements are of course the design professional's raw materials. There is increasing awareness that design attempts to create interest, desire and even stronger emotions based on the product's outward appearance, therefore understanding of how these design elements are seen is essential in this process.

The investigation aims to evaluate and quantify visually perceptible differentiation in products by establishing a model for object analysis and applying it in the context of ceramic tableware production. The model will provide quantitative and qualitative information on the underlying principles of product differentiation. The resulting knowledge will make an academic contribution to object analysis and an industrial contribution to marketing research and consumer testing.

There is an industrial context to the investigation, anchored in the need for visible product differentiation (Dickson, 1987). Today's tableware consumer demands individuality of design and shows a more modern preference for clean and clear shapes with relatively little ornamentation and pattern. Despite the industry's readiness to comply, the New Product Development effort is wasted if the offered differentiation is not visibly noticeable.

The ceramic tableware industry presents itself as an ideal candidate to have its production examined: its change is typically incremental in nature and production processes often limit its design efforts to surface decoration, avoiding the more costly shape design: 'the least risky form of product innovation is a style change in an established product' (Heany, 1983:4). This

context poses a problem, for if designs are to be kept simple, even monochromatic, this industry's traditional innovation techniques must be reconsidered and their effectiveness reassessed.

McGovern alerts to the need for specific research that links differentiation and perception: 'although many writers seem to imply that differentiation is based on customer perceptions, the connection between the intentions of the firm, and the subsequent perceptions of the customer is not well explained' (1987:5).

There is also an academic audience for a model that analyses visual perception of three-dimensional objects: 'the number of commercially available tests that centre on the perception of visual form is small, and only very few of them test and predict form perception as such' (Zusne, 1970: 393).

Theory

Differentiation

The benefits of innovation are frequently cited in reports on market trends, showing that the consumer tends towards frequent new propositions, bringing with them design diversification and differentiation (Ecotec, 1999; Mintel, 2001). EDI (2003), or Exploring Design and Innovation, asserts that consumers desire uniqueness in products to meet individual needs.

Innovation can be defined as a specific tool by which change can be exploited as an opportunity for differentiation (Drucker, 1985). Tidd (2001:6) agrees and summarizes by stating that when considering innovation 'essentially, we are talking about change'.

Some products are extensions of an organisation's existing product range: incremental innovations (EDI, 2003). Fussler and James (1996) suggest that the incremental evolution of a product is not innovation: adding features to a product so that it visually supersedes the previous model, they propound, is merely a way of turning over sales, rather than innovation. Incremental change builds on prior designs, is less evident and more comfortably accepted by the greater slice of the market.

Aimed at sales, product differentiation is a strong weapon, but the question beckons: different from what? When a company launches a new, differentiated offer on the market, it will be compared to all the 'near substitutes' contemporarily available – this includes any of the products of that company itself. Accidentally or not, company products compete amongst themselves. The idea is not clearly stated in the literature (McGovern, 1987), but it is around this notion, around the comparative visualization, that the present study is structured.

Incremental initiatives can be considered as those designs that spin off the existent catering to customization and the individuality of the buyer. This suggests a need for more options that are different while still allowing composite mechanisms such as mixing & matching and accessorizing of products within company ranges. Clearly there are degrees of novelty and Tidd (2001:6) argues that 'it is the 'perceived' degree of novelty which matters; novelty is very much in the eye of the beholder'.

Visualization

Principles of visual perception have long been established and are cemented on physiological factors of vision and brain operation. 'By making visual categories explicit, by extracting underlying principles, and by showing structural relations at work, the survey of formal mechanisms aims not to replace spontaneous intuition but to sharpen it, to shore it up, and to make its elements communicable.' (Arnheim, 1974:8).

Pictorial form can be determined essentially by four factors pertaining to: structure of the images, formative powers of the visual apparatus, the need for observing, selecting and understanding and personal attitudes and moods. This study investigates the first factor: the

visible structure of objects. Whereas taste, background and moods may, and do, waver, how we see and what object properties are more evident under what conditions have been systematized as more stable.

The investigation builds on Gestalt principles of visualization in a positivist approach. The 'rules of visual grouping' established by Max Wertheimer in the beginning of the 20th century, may be reduced to one, namely the Principle of Similarity, which states that, 'the relative degree of similarity in a given perceptual pattern makes for a corresponding degree of connection or fusion. Units which resemble each other in shape, size, direction, colour, brightness, or location will be seen together.' (Arnheim, 1968: 201). This inherent tendency supports the need for visible differentiation in product appearance, otherwise the plethora is seen as a mere handful: many designs producing a single, same effect.

Lengthy and detailed explanations of the Gestalt theory, its principles and experiments, have filled many volumes. What is central and to be considered here is the possibility behind the concept: formal quantification, the precise and countable ways of relating form and perception.

This possibility is made clear and expanded upon by J. J. Gibson (1950). In describing a visual world different from the visual field, (i.e. an objective attitude different from a subjective one, both of which are not mutually exclusive) he leads psychologists into the more comparative and relational physical territory of psychophysics.

Methodology

The study uses methods proposed for object analysis, visual analysis, visual perception and psychophysics. At first, generic object analysis seemed appropriate for the sought after comparative evaluation. However, the question of how to observe these objects and how to measure and express the thesis of the small differentiation between their designs soon arose. Methods proposed for visual analysis were investigated to clarify the first doubt, then visual perception and psychophysics as means of quantifying and qualifying visualizations were studied to answer the second.

The constructed model proposes an alternative method elaborating on physical properties of the objects investigated according to principles of visual perception and measured by psychophysics formulas.

Studies closely related to the present project have used computer 3D morphing techniques to determine recognition and preference of kettle shape designs (Lin, 2003) and Weber's Law of Just Noticeable Differences (JND) to quantify the change necessary in a stimulus to produce a noticeable variation in sensory experience (USD, 2003). Once again, a merger is proposed: by using morphing tools, a form spectrum can be created of any type of product and a scale of visually perceptible differentiation can be established much in the way psychophysicists have done using JND.

Object Analysis

Literature on research into physical product features falls into three different areas: product properties, the design activity and the observer.

In the design literature, objects are commonly categorized according to either visual or functional properties (Riggins, 1995). Studies have tried to understand specific qualities, such as proportion (Lee, 2002), geometry (Birkhoff, 2003), form (Conolly, 2003) or function (Guyer, 2003) and their contribution to perceptions of products. This study will take a more holistic view of the product, investigating spontaneous visual reaction.

Various attempts have been made at demystifying the intuitive process by which designers create. Attention has been given to the information (Chang, 2003), properties (Ding, 2001) and tools (Wiegers, 2002) necessary for optimal design results.

What is seen depends, to a certain degree, on the observer who has been studied as a consumer/user (Kano, 1984), a human being (Maslow, 1962) and an instrument of visualization (Coughlan, 1999). Here, if the observer is considered as a generic instrument of visualization, how much of the differentiation in one design compared to the next is visually perceptible? What influence does composition and organization exert on perceptions of similarity and contrast? What design elements or features are responsible for the identification of alteration?

Visual Analysis

To study articulated objects, composed of more than one design element, Gillian Rose (2001) suggests compositional interpretation, the 'good eye' as she calls it. This type of analysis concentrates mainly on the compositional modality of the image and requires total attention to it. According to compositional analysis, some of the key components in an image are its content, colour, spatial organization, light and expressive content.

Rose goes on to suggest content analysis as appropriate in dealing with large samples in a systematic fashion, guaranteeing it is a qualitative, as well as a quantitative technique, which requires little reflection. Krippendorff (1980) expands on this method of analysis. From him we take the structure of content analysis and use the idea of sample and category definition, coding, interpretation and validation processes in the model development.

Visual Perception

Visual perception aids in relating the visual object to the visualized one. As a consolidated discipline, various branches sprang from the German Gestalt School. All of these lines of inquiry tackled the study of human visual perception less as a speculative undertaking, more as a crucial demonstrative experiment.

It has been mentioned that in visual perception, studies concentrate on the two-dimensional representation of, normally, tailored images, created to prove or test a hypothesis. Gibson is openly hesitant towards the Gestalt laws claiming that because these psychologists were concerned with the projected form and developed their principles on organization using two-dimensional shapes, their understanding of form perception is somewhat skewed.

An offspring of the Gestalt School, Rudolf Arnheim (1974) takes his instruction on visual perception to the field of fine and applied arts, relating them to the making and visualizing of the creative work. Much of what had already been defined using fictitious, fabricated visual stimuli, is by him demonstrated on real images and objects. Describing form, he calls attention to the most adequate angle, the view in which the three-dimensional object is most explicit, less violated by the flat representation.

Psychophysics

Psychophysics is the attempt to find the physics of the body. It consists of applying a physical stimulus to a subject, and then getting the subject's report of the psychological experience associated with that physical stimulus (Lodge 1981).

One of the discoveries is the notion of threshold – a psychological limit to perception. The absolute threshold is the lowest amount of sensation detectable by a sense organ. The relative or difference threshold is the lowest difference in sensation detectable.

Both the absolute and the relative thresholds are not points on a scale, rather they can be thought of as a range. The theoretical threshold is a point: when one reaches a certain intensity of stimulation one is able to detect it. However, in actuality, thresholds are ranges.

Ernst Weber was the first to describe the difference threshold mathematically D I / I = C. Weber's law can be stated as follows: for any particular sensory system, the ratio of the

difference in stimulation divided by the original stimulation is a constant. Different sensory systems have different constants.

Gustav Fechner, working at the same university, but unaware of Weber, discovered the same law, but stated in an equivalent mathematical form. The answer of psychophysics to the psycho-physical relation is given in the generalizations known as 'Weber's Law 1', 'Fechner's Law', 'Weber-Fechner Law' or the 'psychophysical law', all of which profess to formulate with exactitude the existent relations between change of stimulus and change of sensation.

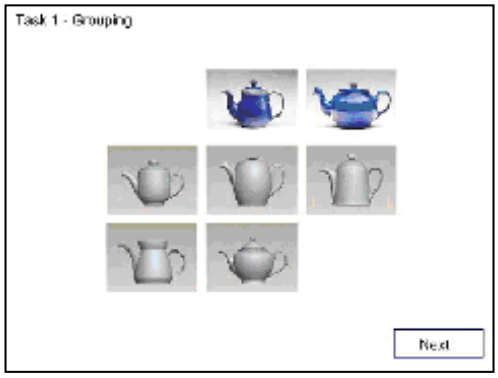
Hundreds of experiments in psychophysics have shown that people can make very accurate proportional judgments about visual, auditory, and other sense stimuli. Modern psychophysical research has generally abandoned the Weber-Fechner law, and instead uses a 'power law'. The most notorious Power Law is possibly Steven's (1957) derivation.

Case Study

Content analysis framework was chosen to guide this two-stage project. This paper describes the first stage which involves the building of the model: defining the sample, categories and properties to be measured, appropriate coding system and coders as well as scaling units for quantifying visual differences.

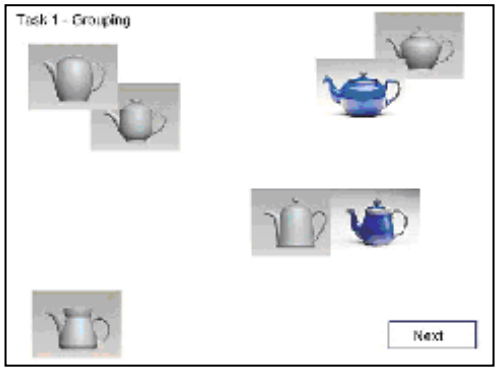
Traditionally a design-led company, the UK based tableware manufacturer Denby Pottery Plc, displays real interest in shape development. In its contemporary ranges, there is a minute use of pattern decoration concentrating instead, more heavily, on glaze. This emphasis assists the investigation's analysis of issues of visual perception of form and shape.

Teapots are seen in the industry as expressive pieces, iconic tableware items. They are used to this day as standard design-and-making exercises in decorative arts academies and for the establishment of a professional's kudos as a practitioner of high design (Julier, 1998). The 7 teapots currently produced by Denby, simultaneously occupying the market place, will compose the object of study.



The second stage is currently underway where the model is put through appropriate testing. A computer-based assessment tool is being constructed to enable testing of the model. Four tasks were set in order to establish formal categories, measure degrees of visible physical difference and identify design features responsible for detection of shape differentiation.

Depending on the exact nature of the final model, a representative sample of observers will be chosen for a pilot run, thereby testing the model's validity and replicability. In any case, background, make-up, niche or class will not be a factor in selecting the testers but may be considered when statistically analysing the results.



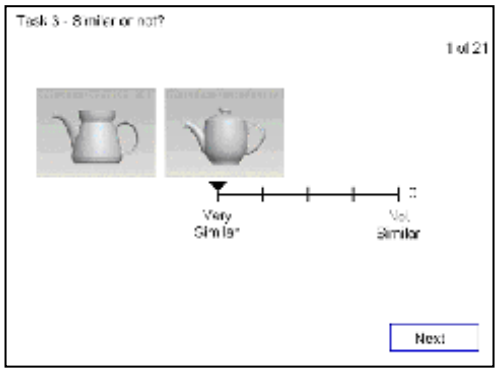
Task 1

The interface (Figure 2) shows all 7 teapots used in the 3D representation grouped based on physical similarity. The subject selects at random and reorganizes by dragging the teapots, clustering those that he sees as belonging to the same formal category. The exercise is devised so that there is room for each object to stand alone in an individual category if the observer perceives them as presenting no resemblance whatsoever with each other. Mindful of the visual tendency to group similar objects, the experiment aimed to induce as little as possible. Therefore, leaving physical room on the screen was important in reducing forced grouping. It is a matching activity where one should not feel compelled to find a pair or right fit for each object.

The program registers the order of selection, time taken for selection and possible changes in grouping. Data are assessed based on object proximity and the idea that more obviously different objects are more readily picked. Slower, more time-consuming decisions on grouping may suggest unclear differences and/or similarity of the object with others.

Task 2

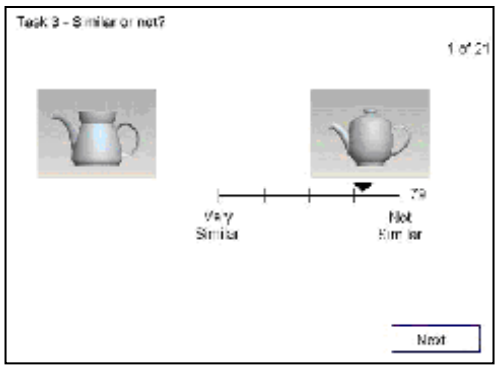
The second task also involves grouping but the tester is merely asked to scale how similar or dissimilar two teapots are, resulting in a Multi Dimensional Scaling of the objects. In order to visualise the similarities, the last screen presents the tester with the possibility of confirming the similarity resulting from this more quantitative assessment.



Task 3

The third and fourth tasks involve morphing animations of the 7 teapots, where one morphs into another, until each has been paired up with all the other 6. With this material, it is possible to test for absolute threshold (task 3) and difference threshold (task 4).

When seeking to determine the absolute threshold, the stimulus is changed in small steps to find the point at which the observer's response changes, i.e. when he sees a difference. Here, the aim is to watch the morphing animation, say of teapot A into teapot B, and stop the transformation when a change is noticed. The viewer should then mark the place on the object that triggered off that detection of change.

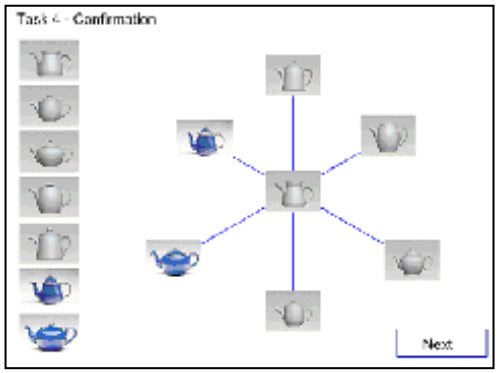


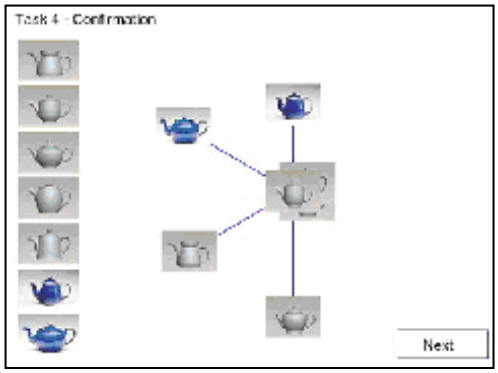
Task 4

Difference threshold is essentially comparative, it presents the standard stimulus and the altered comparison. Specifically in this case, the standard stimulus is composed of the two original teapots and the altered comparison is a frame from the morphing of the two. The observer sees on the screen the two original teapots and is shown a random frame of the morph. The mutant design should be dragged and dropped onto the original teapot it resembles most.

In both tasks 3 and 4 what is being documented is the morph frame and its percentage make-up (%A/%B). In the first test, the frame that triggered the change detection is recorded while in the second test, it is the morphing percentage make-up of the frame identified in relation to the original teapot (A or B) which is considered.

The data this task offers are numerical and easily measured according to Weber's Law of Just Noticeable Differences or Steven's Power Law. Qualitative information is also available in the design element, marked in the first test, responsible for triggering off change detection.



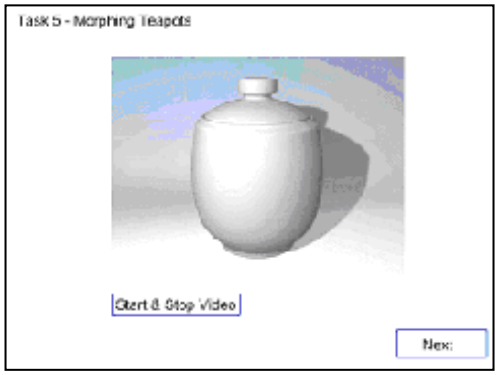


Expected Outcomes

The first outcome of the investigation is an evaluative model by which visual perception of product differentiation can be assessed. The model will make direct visual comparison possible and quantifiable based on principles of psychophysics.

The interpretative result of applying the model to the case study is the second outcome: information on visually perceptible differentiation between teapot designs. Analysis of the results will produce quantitative information, or frequency, counting significant relations between codes: *How many are different*. Qualitative information comes from a conclusive interpretation of the visual reading: *How different*. A final quantification will establish: *How many are **really** different*.

There is a contribution of new knowledge to effective design differentiation techniques and to the comprehension of product appearance. The new knowledge resulting from this study benefits both academics and industrialists. Researchers in areas such as design theory, visual perception and material culture will be able to use the model for their own purposes. The findings fuel consumer testing in an industrial application. Both design and marketing professionals will benefit from clear concepts on visualization of differentiation when developing new products and strategies. The newfound information may also open industrialists to different ways of thinking about product differentiation and market research.



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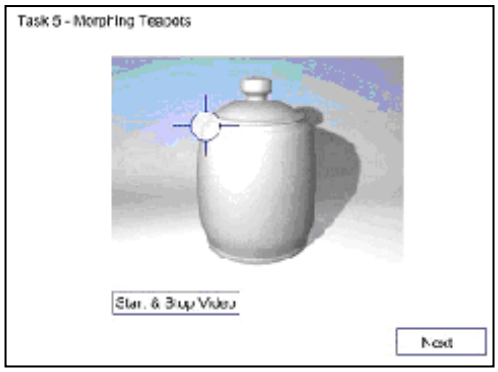

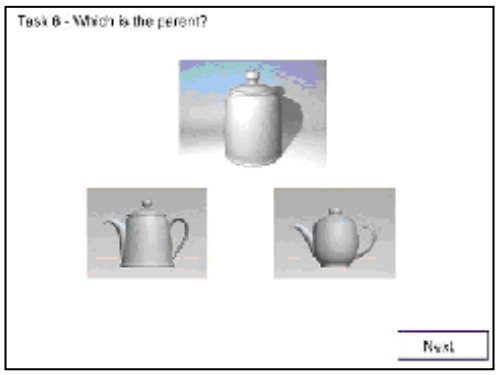

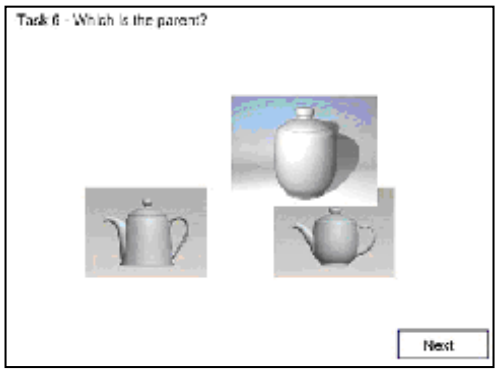

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