The Importance of "Feel" in Product Design Feel, the Neglected Aesthetic "DO NOT TOUCH"

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Abstract. The urge to touch and feel objects is universal and powerful but focused scientific attention to understanding and enhancing the aesthetic portion of the total "feel" of a product in order to increase user satisfaction has been noticeably under emphasized in consumer product design and thus in the products themselves. Although the tactile, proprioceptive and kinesthetic senses are vital to life, in their larger context of "feel", they have been largely ignored compared to the senses of vision, hearing, taste and even smell. And while courses, institutions, and venues are dedicated to these latter senses, comparable ones for the former are decidedly absent. Recent interest in the haptic senses may be a sign of change. This paper explores several aspects of "feel" and offers suggestions for research areas.

Keywords: Touch, feel, aesthetics, moment-of-inertia, haptics.

1 Introduction

"**DO NOT TOUCH**" is a commonly encountered prohibition in museums, shops, factories and other places throughout the world suggesting that the desire to touch and feel objects is universal as well as powerful. The reasons for the prohibition are fairly obvious – to prevent object deterioration and damage, to prevent breakage or theft, and to prevent injury. (There are also the strong cultural prohibitions on touching another person, particularly a stranger.) On the other hand, reasons for the initial desire to touch are not so clear. Try to answer two simple questions. Why do I want (or not want) to touch an object? What satisfactions (or dissatisfactions) do I derive from "touching"? The images in Figure 1 can serve as targets for the answers. Sometimes curiosity overrides the prohibition such as the urge to touch wet paint or a hot surface – "just to see" or a child's natural and learning curiosity. For sighed people, vision precedes the urge to touch (or not) and tactilely explore an object suggesting that there is an imagined "feel" we want to confirm or enjoy.

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Fig. 1. DO NOT TOUCH!

Fig. 2. This LOOKS like it would be pleasant to hold and FEEL

The object in Fig. 2 for example can suggest a form that would "feel good" in the hand. However its polished surface suggests that it may be easily slip from the hand.

We may have no clear mental idea what the target may actually feel like and we want to know – a curiosity factor. In the case of desiring not to touch, discomfort or damage to self or object likely covers most reasons. Prohibitions on touching persons abound.

Although "DO NOT TOUCH" signs abound, "PLEASE TOUCH" signs seem only found in exploration museums or venues primarily for children's educational reasons.

"*Haptic*", derived from the Greek *haptikos*, from *haptesthai*, meaning to touch or grasp, is a relatively recent interest in science and design. According to Wikpedia [1], "Gibson [2] defines the haptic system as 'The sensibility of the individual to the world adjacent to his body by use of his body'. The haptic perceptual system is unusual in that it can include the sensory receptors from the whole body and is closely linked to the movement of the body so can have a direct effect on the world being perceived. The concept of haptic perception is closely allied to the concept of active touch that realizes that more information is gathered when a motor plan (movement) is associated with the sensory system, and that of extended physiological proprioception a realization that when using a tool such as a stick, the perception is transparently transferred to the end of the tool."

According to Gabriel Robles-De-La-Torre [3]: "Haptics is commonly used today to refer to the science of touch in real and virtual environments." This would include not only the study of touch capabilities in different organisms, including humans, but also the development of engineering systems to create haptic virtual environments. The latter subfield is commonly known as computer haptics. "This technology does for touch what computer graphics does for vision."

However, haptic literature seems centered mainly on such worthy goals as developing virtual objects to feel and for interface design such as touch screens, hand controls, etc. This paper however wishes to address the largely unconsidered area of haptic aesthetics particularly for product design. Because of the very underdeveloped state of haptic aesthetics, we can only begin such discussion but with the hope that it will generate more of the same leading to research and development of this neglected area for product design.

Consumer products, many of which are held in the hand for use, are generally designed with careful attention to their function and visual appearance and increasingly some ergonomic aspects. One may think of iPods, pens, pencils, razors, golf clubs, tennis racquets, lighters, CD players, knives, forks, drum sticks, hammers, computer mice and many others from a near endless list. Attention has been paid to the "feel" of buttons and keys in interface design. Similarly, the safety razor has had designs influenced by the "feel" of the razor in the hand [4, 5] and which has been found to have a decided influence on the *perceived* quality of the resultant shave. We emphasize *perceived* because in consumer products, perception can be critical in terms of purchase, use and judged performance of the product. In fact, the single most challenging aspect of consumer product design is addressing the user's multi-dimensional, multi-attribute *satisfaction* with a product.

But generally, an object's entire "feel" as an aesthetic is rarely discussed or thought about. Little thought seems to have been paid to designing a product so that by its visual appearance alone, a person *wants* to feel it or attends particularly to the aesthetic aspects of its feel or expresses satisfaction with how it feels. Merchants who position their products behind barriers so they cannot be touched may lose sales for this reason. Or conversely, if potential purchasers are permitted to handle and feel a properly designed object, the probability of its purchase may be significantly increased. At a deeper level, designing a product so that it *looks* like it would be pleasant to hold and feel may precede the desire to hold it in the first place. Faithful but otherwise functionless models of objects may be provided for sales purposes so that potential customers can experience how they feel.

What is this urge to touch an object and derive pleasure from it? Fig. 3 shows a medicine horn carved from an animal leg by the Bahau people of Borneo. It is pleasing to look at but also to feel with the hand and fingers as they explore the polished surface, curvatures and detailed carving. Holding and caressing it generates distinct pleasures and the consequent desire to possess it in some people. In fact, simply looking at it generates mental haptic aesthetics. As in Fig. 2, it *looks* like it would be pleasant to touch and if the mental impressions are attended to, one can almost feel it in the mind.

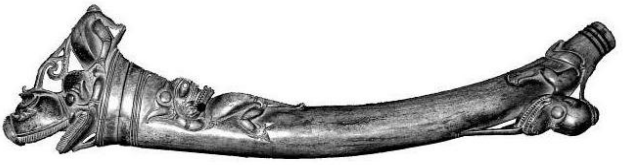

Fig. 3. Carved Medicine Horn of Bone. Bahau people, Borneo

Product designers need to explore more deeply the "feel" aspect. Not just texture but actual shape. Several simple questions are: Why do people want to touch and feel it?

What haptic sensations does the *appearance* of the object of the object evoke? What vocabulary would people use to describe their haptic sensations? These are basic design questions. Further questions are: how can the designer purposefully create an object to produce desirable haptic sensations. How can the designer create an object that mentally evokes haptic pleasures so that people want to hold and touch an object? The design question is: *how can one design an object that someone actually wants to touch*, or its complement: how can one design an object that someone does NOT want to touch. Sometimes the negation of a position can illuminate the positive.

Fig. 4. Brancusi's "Sculpture for the Blind" ca. 1920, Veined Marble, Philadelphia Museum of Art, The Louise and Walter Arensberg Collection, 1950

In investigating such questions, the blind who rely so largely on their haptic senses could likely provide useful information and hints for answering such questions. Sculptors, potters, weavers, etc., who work directly with three dimensional forms under their hands should also be a source of help. The artist Constantin Brancusi [6] for example sculpted a series of "sculptures for the blind" in the first quarter of the 20th century which supposedly the blind were to touch, feel, and caress to impart aesthetic sensations. Figure 4 is such a form.

Several museums attempted to give the blind an appreciation of visual art by making a simulacrum of a painting through raising outlines of its forms so that they may be felt. However, this would seem to be like providing pictures such as in Fig. 3 and 4 to the sighted so that they may derive the same pleasurable sensations as do

those fortunate enough to actually feel them. Both attempts would seem to miss the point. Figure 5 shows a highly efficient as well as pleasant feeling (and looking) tool from a tribal people of Borneo.

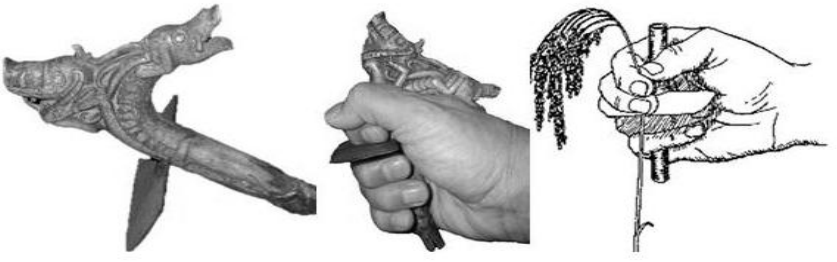

Fig. 5. Hand Conforming Padi Cutting Tool From Borneo

Beautifully carved from a deer horn, its natural shape is used to advantage so that tool-grips-hand rather than the usual hand-grips-tool.

This frees all of the fingers and reduces the finger forces otherwise needed to hold and stabilize the tool. In use, the index finger (and perhaps middle finger) above the blade gather in a stalk of padi and pull it naturally against the blade severing it for harvesting. Such designs suggest that perhaps products should be designed to "hold the hand" rather designed for the hand to hold them.

But deep problems revolve around the "feel" of an object. For example, Hill, et al. [4, 5], have explored aspects of an object's moment-of-inertia as a contributor to its "feel" and established among other things that even though subjects had little understanding or even conscious awareness of this basic physical property, they had definite preferences for specific values of it and could distinguish (unknowingly) between an object's moment-of-inertia and its weight (which can be independent properties). A problem that plagues designers, and one which may be typical, is that even though subjects did have such preferences for moment-of-inertia as opposed to weight, they were actually unaware of it and so would not be able to communicate these to designers who themselves might be of this fundamental property.

Furthermore when subjects did try to describe the difference in "feel" between two objects of exactly the same weigh and balance, but different moments-of-inertia, they used words most appropriate to weight because they lacked any design useful words for the sensations evoked by the moment-of-inertia – a property only "felt" when the subject imparts some rotation to the object.

This can lead to frustrations and ultimately misdirected design because the designer, implicitly trusting the subject's inappropriate vocabulary, e.g., "too heavy" when it should really be "too great a moment-of-inertia", can addresses the wrong design parameters.

2 Existing Research

The Integrated Media Systems Center of the University of Southern California in Los Angeles proposed a Haptic Museum in which virtual objects would exist for touching. Jessica Persdotter Isaksson [7], in industrial design and engineering at Chalmers University of Technology proposed what seems to be a directed research program for "the study of the human haptic sense and interaction with products and environments".

The sensitivity of subjects to the moment-of-inertia of handheld objects such as razors and tennis racquets and the ability to distinguish weight from moment-of-inertia has received some attention.

In one study [4, 5], subjects were allowed to change the center of gravity (CG) of a mocked-up but realistic and functional razor by sliding an interior weight up or down its handle by a small protruding button while shaving until they "liked the feel" of it. This was done for different razor weights. Changing the CG in the experiments also changed the moment-of-inertia (I) of the razor. The moment-of-inertia is a measure of how much the weight is spread out using the CG as its center. The higher the value of the moment-of-inertia, the farther out from the CG the weight is "smeared". It is similar to the notion of the variance of a weight distribution. A related measure of how the weight is spread out is the radius-of-gyration (RG) which is akin to the standard deviation of a weight distribution.

The results in Figure 6 show that the lighter the razor weight, the higher the preferred CG measured from the end of the razor and the greater the preferred RG. That is, the preferred RG increases with the preferred CG. Alternatively, the moment-of-inertia (I) decreases with increasing preferred CG. Psychophysical experiments made clear that subjects were sensitive to moment-of-inertia without knowing what it was. Moreover they commonly used words descriptive of weight in describing the difference in "feel" of objects with the same weight and balance (CG)

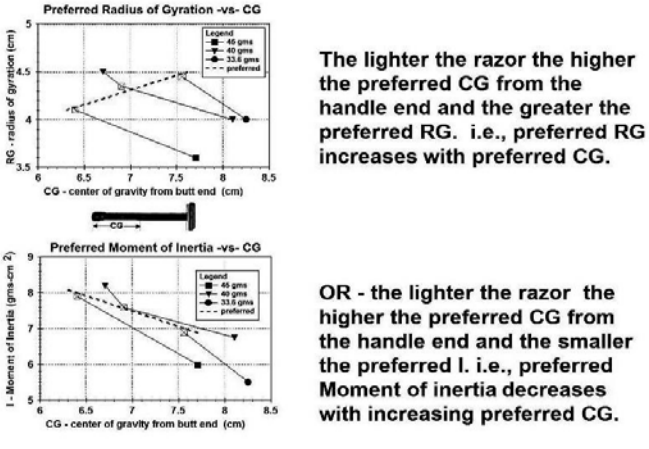

Fig. 6. Preferences in Razor Design

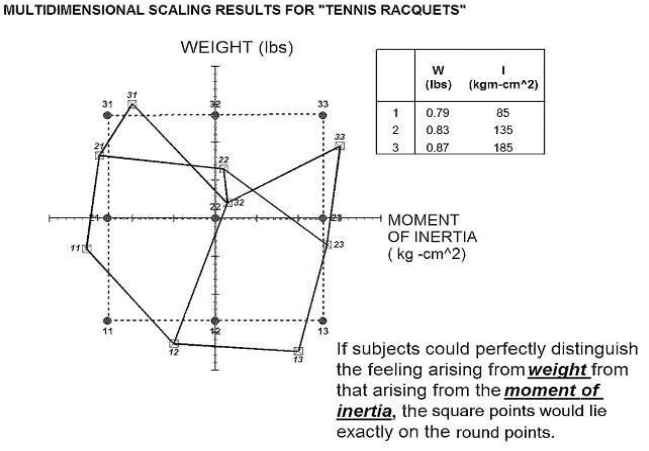

Fig. 7. Ability to Distinguish Subjective Feelings of Weight (W) and Moment-of-inertia (I)

but different moments-of- inertia. The problem is that the vocabulary for describing the "feeling" of moment-of-inertia does not exist for all practical purposes. Moment-of-inertia can be described as the resistance felt when an object held in the hand receives some rotation either alone or in addition to translation.

Kreifeldt and Chuang [7] established the psychophysical sensitivity to moment-of-inertia. Chuang [8] investigated the ability of subjects to distinguish, even unknowingly, weight from moment-of-inertia using 9 baton like stimuli in which weights and moments-of-inertia varied independently. Subjects held and swung them somewhat like tennis racquets in pairs. Using multidimensional scaling techniques, Chuang found that based on nothing more than a "feeling of similarity" between any two batons on a scale ranging from "identical" to "not at all", subjects were basing their responses on subjective distinctions between the two physical variables. Figure 7 shows the subjects' "perceptual" space in which the two physical variables [W,I] are plotted together with their perceptual equivalents. If subjects could perceptually distinguish weight from moment-of-inertia perfectly, the solid grid would overlay the dotted one exactly. What is clear is that even though the batons of any pair might "feel different", subjects were in fact perceptually aware that weight "felt" differently from moment-of-inertia even though they were unaware of the latter as a physical property of a body. Moreover, Fig. 8 shows that when subjects were asked which of a pair they liked the "feel" of better, they clearly had preferences such that a perpendicular to the arrow would rank the 9 stimuli on this criterion such that preference for the feel increases along the arrow's direction. Based on Figure 8, a designer could design, say, a 10^{th} similar stimulus so that its "feel" would be preferred to any of the other 9 by locating is W and I on the arrow and outside of the subjective configuration. And again, even though the subjects were not aware of I as a property and certainly not able to vocalize about it. - i.e., while they might be able to say "make the weight lighter" - they had no vocabulary such as to say "make the moment-of-inertia less.

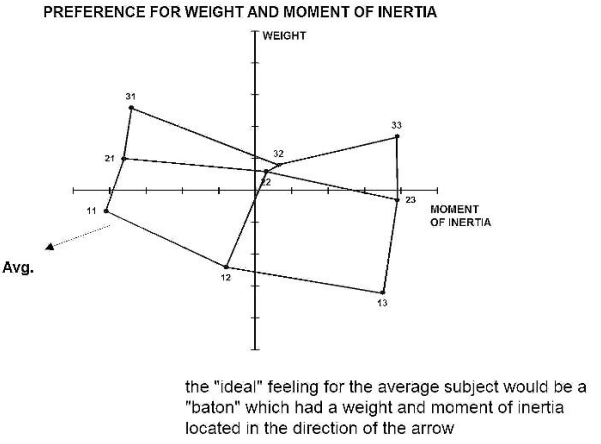

Fig. 8. Subjects Can Express a Preference for I Despite Not Knowing of Its Existence

So why the neglect of the haptic sense?

Perhaps feel is largely a utility sense necessary for survival and not suited to delivering aesthetic pleasure as do the other senses. But that can't be correct when we think of the pleasure we get from holding our new baby or a loved one or being touched by a mother's cooling hand when we are distressed. There is "the tactual luxury of stroking silky hair" of humans or pets or even clothing.

Or on the opposite pole, it is unpleasant to be touched by someone we dislike. We don't like strangers touching us particularly on purpose. In fact most societies have an unconscious distance to maintain between people if possible.

Many people derive pleasure from movement as in dancing or sports which includes the sense of proprioception and kinesthesia – the awareness of the position and movement of our limbs. Watching dance or ballet can be very pleasurable and spiritually engaging because of the dancers' movements as perceived and perhaps translated into an interior feeling by the spectator. Many of us also enjoy the feel (perhaps coupled with the sound) of "popping" those air bubbles used in packing materials. There certainly are moral and immoral connotations to feel. The immoral ones we can imagine. Moral sensations from touch could be evoked in religious ceremonies such as by the "laying on of hands" and clasping the hands together in prayer.

If we were all blind, would we have developed haptic art? And would it have developed as the other arts have?

The first use of haptic devices in entertainment may have appeared in Aldous Huxley's 1932 novel *Brave New World*. He described an entertainment theater of the future in which devices in the arm rests could deliver haptic sensations to the hands.

These theaters provided" *feelies"* rather than *movies*. Rather unimaginatively, the "feelies" were of an erotic nature. Which, however, may be a main reason why the haptic sense is so "ignored" or skirted around because it is uncontestable that sexual arousal is strongly related arguably more to the haptic sense than to any of the others.

3 Suggested Haptic Aesthetics Research Areas

As mentioned, the worthy ongoing haptic area studies appear devoted to interface design and virtual object perception. However, for the purposes of product design several research areas suggest themselves as pertaining to haptic aesthetics.

1. Multidimensional (MDS) studies of object shapes for **similarity** and **preferences** in shape "feel".
2. The attributes of shape which are the underlying dimensions in the MDS studies. Is it possible for example to construct shapes from primitives? The artist Leger painted forms by breaking them down into geometric solids such as cones, spheres, etc. Perhaps something similar exists for shapes based on feel such as 3-dimensional primitives like spheres, cones, cubes, wedges, etc.
3. Development of a vocabulary for "feel". E.g., what words do we have to describe an object's "feel"? The word "feel' is not very precise. Vocabulary for the haptic sense is a particularly barren area. As mentioned previously, there does not seem to be any common word to describe the feeling associated with an object's moment-of-inertia. Our vocabulary for describing "feel" sensations is particularly limited and may be counter to the underlying physics.
4. More attention to the psychophysics of "feel".
5. Convene a panel of sculptors, blind people, crafts people who work with their hands etc., to discuss the role of "feel" in their work and life.
6. Synthesize a product form from fundamentals that "feels good" to hold.
7. List the design parameters needed to be considered such as: weight, balance, moment-of-inertia, shape, texture, resilience.
8. Design a form from fundamentals which looks as though it would "feel good" to hold.

4 Conclusion

This paper can only be considered a plea for scientific and design attention being paid to haptic aesthetics. The "feel" of an object is an important aspect of the pleasure it can give a user and as such a legitimate and important aspect of product design. We will know progress is being made toward a scientific and design understanding and implementation when we can design an object to "feel" as we want it to. That is, when we can articulate how we want it to "feel" and then construct the object from design "feel" primitives. Haptic aesthetics may be the last frontier of design.

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