The Role of Aesthetics in Engineering

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Abstract

Engineering involvement with aesthetics is vital for the creation of innovative and successful products in today's fast changing world. This paper discusses the nature of this involvement, and goes further to argue that aesthetics plays a central role in the creative process itself. Thus, if engineers are involved in the creation of products, or if they wish to become more creative, it is important that they be sensitive to the aesthetic implications of their work and also to their personal aesthetic capabilities. This paper will also examine a few of the reasons why the importance of aesthetics is difficult for the engineering profession to acknowledge.

The source of this thesis is the design program at Stanford University. For almost 40 years, the Design Division of Mechanical Engineering has worked together with the Department of Art to offer a Joint Program in Design. The central philosophy of this continuing collaboration is that successful products require the synthesis of art and technology. Further, we believe that engineers who are equally sympathetic to technological and human concerns in their work will be best prepared to take leadership positions in industry.

What does aesthetics mean? The root of aesthetics comes from ancient Greek: *aisthetikos*, pertaining to sense perception; *aistheta*, perceptible things; *aisthenasthai*, to perceive; *aisthesis*, sense perception. Clearly, aesthetics has to do with human perception. This meaning is clarified by considering its negation: anesthetic. An anesthetic is something that blocks sense perception and makes a person unable to feel anything. Used to diminish pain, it must also necessarily eliminate pleasure. When patients are anesthetized, all sensations are equally eliminated—they feel nothing.

Fortunately, most of us don't spend much of our life anesthetized. Instead we might say we walk around fully "aesthetized." We do feel things. We have the full sensory ability of our body available for use. It is instructive to note that all the sense receptors in our body evolve from skin cells in the embryo. Obviously true for the haptic cells in our fingers, this is equally true for the rods and cones in our eyes, taste buds on our tongues and for the balance receptors in our inner ear. Thus the word *feelings* may be used for perceptions, that is, the raw input that we receive from outside our bodies.

What are we able to do with these feelings or perceptions? They enable us to distinguish hot and cold, smooth and rough, soft and hard, heavy and light, dark and bright, sweet and sour, loud and quiet, sharp and dull, etc. In their conscious state, humans automatically and constantly sense these attributes in the environment around them.

Linguists use these shared human perceptual abilities to determine the meaning of words between different languages. If they wish to know the real meaning of the word 'love' in English compared to 'amore' in Italian, or 'ai (愛)' in Japanese, they ask native speakers of each language to rank the word on a scale one to seven between hot and cold, smooth and rough, sweet and sour, etc. Using this technique, called semantic differentials, they may find, for example, that 'amore' is hotter than 'love,' and this way begin to understand the difference between meanings in languages and cultures.

The distinction made between art and engineering is often described as the difference between warm and fuzzy, and hard and cold. As we can see, this is an aesthetic distinction. The perception of hot and cold comes to us through feeling. Fuzzy is part way between smooth and rough. Warm is part way between hot and cold. Hard is distinguished from soft. None of these interpretations are literal. When engineers consider artistic concerns as being 'soft,' they mean easy. When artists say engineers are cold, they don't mean to the touch. They mean they are impersonal.

Engineers often believe they are not able to make aesthetic judgments. Yet as the 'techie vs. fuzzy' example shows, this isn't true. All humans, including engineers, use aesthetic distinctions to understand the world around them. Indeed, they must in order to survive.

When designing an object, distinctions between design alternatives may be made in a way similar to the semantic differentials described above. Visually, a Volkswagen 'bug' is 'softer' than a Lexus, which is 'softer' than a Cadillac. People can make these distinctions even though these cars are all made out of steel and are thus equally 'hard' in a literal way. This insight becomes more significant when one realizes that feelings are the raw data from which humans draw conclusions about everything they know and believe. Continuing the automotive example, because the Volkswagen Bug is perceived as soft, warm and sweet, people think of it as being friendly. In other words, aesthetic sensations are the building blocks of emotional response. We ascribe meaning to different combinations of sensory input. A machine that is perceived to be cold, hard, and smooth may be seen as being precise. Add dark and sharp and the reaction may be one of fear—we assume it is dangerous. How customers feel about products, is literally a result of their feelings. They will combine these attributes and come up with conclusions or expectations regarding attributes: precise, reliable, enjoyable. This is the way the word feelings (sensory input) gets interpreted as feelings (emotional response, or even beliefs).

This is how humans come to have perceptions of quality. Manufacturing engineers make great efforts to control quality by the use of measurement. Yet at its core, quality itself is unmeasurable. Quantity is quantitative, quality is qualitative. If this isn't true, then words have no meaning. It is relatively easy to measure something after it has been identified as having to do with the perception of a desired quality. The quality perception itself precedes this recognition. Aesthetic awareness allows one to see an issue where none existed before. When Toshihiko Hirai of Mazda was designing the Miata, he realized that the sound of the car was an important issue in the perception of sportiness. Exhaust notes could then be categorized and measured, and an appropriate sound could then be designed. In making this into an issue, Hirai was making a quality judgment based on aesthetic awareness.

This story brings us to the second reason aesthetics should be valued in engineering: insights based on the raw material of the senses are the key to creativity. Not only do aesthetics play a key role in the perception and acceptance of commercial products, but aesthetics play a central role in the creative process itself.

When we say something is creative, we are saying that it is new, unexpected and original. Creative ideas are the opposite of normal or conventional ideas. Ideas become conventional because they work and are useful. As they become accepted by a people or profession, they become invisible. Conventional ideas are the unquestioned underpinnings of any culture. Ideas go through a cycle: creative ideas that work become conventional with time and use, and in turn become the ideas challenged by new creative ideas. Creative ideas cannot come by conventional means or from conventional thinking. To be creative, a person must perceive and question something that was formerly invisible to everyone else because it was assumed to be true.

How does one get creative ideas? An important clue comes from the expression 'original thinking.' We must go back to our origins. Children aren't born with conventional wisdom, they must learn it. According to the psychologist Piaget, children go through distinct developmental stages. From birth until about five children live in a body centered stage. Next comes a period in which children value visual information, and finally, at about age eleven or twelve, children begin to think symbolically with adult conventions. Original and creative thinking involves thinking with these earlier skills: kinesthetic and visual thinking. It involves going back to the presymbolic, basic unconscious aesthetic skills that the body possesses.

When the various creative techniques such as Brainstorming, Synectics and Mind-mapping are looked at from this viewpoint, we see that each recreates these earlier mind-sets. Brainstorming requires that participants "defer judgment." Synectics involves "making the familiar strange" with the use of analogy and metaphor. Mind-mapping provides a non-linear form for exploring a topic and questioning basic assumptions. These techniques and many others emphasize the non-judgmental, playful, visual, active, kinesthetic use of the body.

Likewise, when the lives of famous scientists and technologists is investigated, one finds that most had a rich involvement in the arts [1]. Schrodinger was a weaver. Kekule was an architect. Herschel and Maxwell were photographers. Cajal, Ostwald, Egerton, Faraday, Fleming, Kepler and Pasteur were all painters. In fact, Pasteur was such a good painter that a contemporary Finnish artist cried at the loss to French art that resulted from his pursuing biology. Yet three biographers did not mention this skill in their biographies of Pasteur.

These observations bring us to a final question: Why are these issues given little attention by the engineering profession? Why is aesthetics not thought to be central to engineering?

One reason is because the word aesthetic is poorly understood. Aesthetics is often mistakenly associated with surface beauty rather than being defined as having to do with feelings. The association of aesthetics with beauty is a fairly recent phenomena growing out of literary criticism of the nineteenth century. Defined in this manner, it is seen by engineers to be peripheral concern, and, if required, something that can be applied to the surface by a designer hired late in the game to make a product look pretty.

When aesthetics is understood as having to do with overall perceptions of quality, it becomes obvious that most engineering decisions effect the aesthetics of a product. The use of one structural approach over another has a profound aesthetic effect, as does the initial choice of configuration and overall proportions. Even the decision to save a little money on the choice of a small component may have an effect on the final aesthetic impact. As we have seen, aesthetics has to do with the entire spectrum of human perception. How things feel, taste, smell, as well as their appearance. These issues are inherent in objects, not something that can be manipulated at the last minute.

A second reason for downplaying aesthetics is that the engineering pendulum has swung far to the side of science. Engineering today is seen as a largely scientific pursuit that investigates the basic materials and processes of matter in a way only slightly more applied than physics. As a result, aesthetics seems like an alien subject, especially in academia where rewards and respect come most easily to those who fit the scientific model.

This situation is easy to understand given the history of the profession. Before the turn of the century, engineering was an exciting creative field, perhaps too exciting. In the late nineteenth century bridges were falling down weekly and steel mills were blowing up left and right [2]. Scientific thinking began to replace what were then largely intuitive methods. In terms of the “art and science” of engineering, the art portion was seen as a problem. As scientific approaches were successfully applied, new engineering conventions evolved to insure the safety of the public. Engineering has become a largely conservative profession with a large body of knowledge to pass on to new members. As a result engineering education has no time to pay attention to the ways in which famous inventors scientists really worked and got their ideas.

Finally, in the West we have a more fundamental philosophical reason for a general devaluing of aesthetic understanding. We are cursed with Descartes' erroneous conclusion: "Cogito ergo sum," or, "I think, therefore I am." At the time this was a creative breakthrough that strengthened the scientific and political changes of the past two hundred years. But it also had the effect of making the working of the body subservient to the brain. Ignoring our body and our feelings, this point of view also valued content over form. Today we are faced with a world that needs to be more integrated. We have technology that seems to have a life of its own, which many feel is not benefiting mankind. To take one example, we have medical doctors who prefer to talk to their patients, or prescribe tests, to diagnose their illness rather than touch them and thus learn first hand what is needed to heal them.

This problem should be easier to overcome in Japan where there is a long-standing tradition that understands that the mind and body are interconnected, and that the connection between them can be developed with practice [3]. Valuing aesthetics should also be easier in a country where fine craftsmen are considered national living treasures. Are these facts considered quaint and historical? They shouldn't be. If the Samurai could value the arts, then it isn't easy to pass off a concern for aesthetics as indicating softness. These traditions should be a source of richness and effectiveness for engineering.

When engineering is seen as having to do with the application of science to meet human needs, then aesthetics plays a more central role. It is important both for discerning those human needs, and for the creative process that meets these needs. Creative thinking requires challenging conventions, yet conventions insure that bridges don't fall down. How does one teach young engineers the value of both? This is the challenge we face as we enter the third millennium.

References:

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