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Measuring Product Semantics with a Computer

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Measuring Product Semantics with a Computer

With so much recent interest in product semantics, where little existed a few years ago, some designers might conclude that expressive products are a new phenomenon. They might also conclude that product semantics are optional, depending on the designer's choice. In fact, products have always conveyed meaning. Designers have only the choice of whether and how to manipulate a product's semantics. They can try to determine which meanings their designs convey and, at best, they'll choose appropriate ones.

My own interest in semantics took root in the mid-1950's when I fell in with beatnik artists and writers who worshipped Alfred Korzybski, the father of general semantics. Our bible was Korzybski's *Science and Sanity: An Introduction to Non-Aristotelian Systems and General Semantics*. Words, Korzybski says, are not the only raw stuff of semantics. Every human act, every human artifact, is a semantic instrument which conveys meaning.

Inanimate products don't actually speak to us, of course. Instead, we project meaning into them in the form of our feelings, emotions and attitudes—a process already familiar to artists and designers known as empathy (first named by Robert Vischer a hundred years ago but described much earlier, even by Aristotle). Yet, we alone are not responsible for this emotional bridge. Somehow, the object shares responsibility, because some quality in it evokes the empathic response, and causes one set of meanings to color it rather than another.

Feelings: The Meaning of Meaning

Another guiding light of my youth was Susanne Langer, that "philosopher in a new key" who was equally at home developing the emerging science of symbolic logic or explaining art. For Langer, too, all perceived things, from the most premeditated and carefully crafted museum piece to a randomly formed stone, are vessels of meaning.

Feelings. Feelings are the key, the raw material of semantics. Langer stresses in, *Mind: An Essay on Human Feeling*, that we cannot know anything without first feeling it. All concepts, all knowledge, our very ability to think, are grounded in our ability to feel—in both senses of the word. Knowledge of a thing begins with the senses when we touch it and feel it with our hand. But knowledge is incomplete until it touches us, in turn, through our feelings, emotions and attitudes. It is no mere coincidence that, when something fits logically, we say "it makes sense" or "it feels right." (If Langer is right, no computer will ever display true human intelligence until it first learns to feel as humans do; artificial emotion will precede artificial intelligence.)

Feelings are a by-product, in part, of a complex set of physiological events (irregular heart rate, constricting and dilating blood vessels, etc.) known collectively as arousal. Arousal can be triggered by any noteworthy occurrence: a loud noise, a person's name, hunger, sex—or a product of unusual or distinctive appearance.

Once provoked to an elevated state of arousal, the viewer instinctively begins a search for meaning in the stimulus. Arousal cranks up the sensitivity and information processing capabilities of the viewer's nervous system through hormonal secretions and other mechanisms. To abet the information gathering, viewers instinctively turn all their sensory apparatus toward the stimulus.

While eyes scan the object, the nose scans the air for tell-tale odors and taste buds anticipate something more tangible to work on. Senses of touch, kinesthesia (body orientation) and balance also are on the alert for relevant clues. If any components of the sensory nervous system fail to find real, environmental stimuli (as they do in the case of something merely seen), the system obliges the appetites by conjuring imaginary stimuli from the internal storehouse of memories. Every time we have touched sharp edges, our memory has been reinforced. So we feel the edge of a new product, even though we caress it only from a distance with our eyes, and we know it is relatively sharp, not dull. Sharpness thus becomes part of the product's meaning. Similarly, we learn to feel and know with our eyes alone when a product is rough or smooth, hard or soft, light or heavy, and when a surface is sweet or a color is sour. Other sensations, associated with the arousal reaction itself, are more elusive and difficult to

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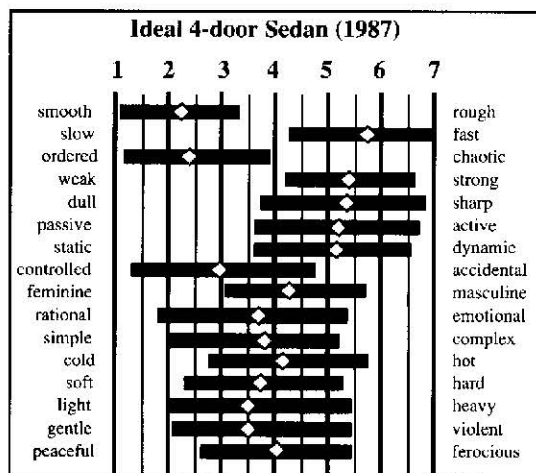


Figure 1: 1987 survey results representing the "ideal 4-door sedan" stereotype. The white diamonds represent mean (average) scores. The shaded bars represent one standard deviation (two-thirds of the subjects' responses) on either side of each mean and indicate the relative consensus among subjects.

label because we cannot see their causes directly—constricting and dilating blood vessels, for instance. These sensations can be especially strong: That first sharp edge we felt as an infant and attempted to taste may have been a knife blade (Ouch!). Usually, though, the mingled sensations have been blunted by time, blurred by multiple exposures to similar events that are not quite identical from one time to the next. So it is difficult to distinguish them or to name them. They are just “feelings,” “emotions” or “moods.” Nevertheless, they color immediate perceptions and the meanings we come to associate with products.

The Semantic Differential

The “semantic differential,” developed more than 30 years ago by Charles Osgood and his students at the University of Illinois, remains probably the most reliable and easily implemented tool for tapping meanings associated with products—or any other object, concept or stereotype. It has been used to measure the meanings of things as diverse as political candidates, motherhood, apple pie and Chevrolets. I have used it in my aesthetics research and as a teaching tool for nearly 20 years. Professionally, I have applied it most often to the analysis of automotive designs. But I also have used it for product design and development of product and corporate names.

The premise of the semantic differential is simple: Anything can be described with pairs of antonyms (hot-cold, heavy-light, sharp-dull, etc.) placed at opposite ends of seven-valued scales. In practice, subjects are presented with a piece of paper with 15-30 scales printed on it. They indicate which word of each scale best describes

the thing being considered by marking the scale closer to one end or the other (or in the middle if no distinction seems appropriate). For instance, subjects usually judge the concept automobile to be relatively “fast” rather than “slow,” “smooth” rather than “rough” and “active” rather than “passive.” To some extent, the same word pairs can be used to measure the meaning of any object. Similarly, subjects have judged the ideal personal computer to be relatively fast, smooth and active. The same pairs could be used, as well, to measure the meaning of motherhood or mother-in-law. Note that, in each case cited, the subject is not referring to an actual automobile, mother or mother-in-law, but to their general concepts instead. I refer to the resulting profile as a “stereotype.”

Surveys are easy to conduct. Instructions are simple, usually printed on the back of the survey form. They are efficient because subjects are urged not to contemplate their judgments. First impressions are the rule. Typically, a subject spends no more than a minute or two on a survey.

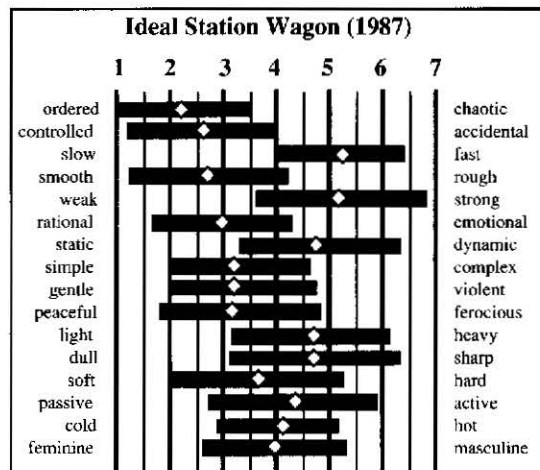
Analysis is another story. Manually recording and analyzing a survey involving just 20 scales and 30 subjects is a time-consuming, error-prone chore. Survey design leaves something to be desired, too, because each subject sees the same form with scales in the same order. Ideally, scales would be presented in random order, with the left-right order of word pairs varied randomly, too.

Using a Computer

To overcome these problems and extend the usefulness of the semantic differential, I am developing software for Apple Macintosh computers that assists in the development, implementation and analysis of semantic differential surveys. The software has three modules. The “Survey Developer” module leads the designer through the process of developing a survey step-by-step. The computer presents a list of over 100 word pairs to choose from for making up the scales (the designer can add to this list). The computer then asks the designer to indicate which subject traits the survey will collect data on (age, sex, occupation, etc.).

Once the survey has been designed, it can be saved and conducted at any time. On launch of the survey, the “Survey Conductor” module leads each subject through simple, graphic instructions (optional, if the subject needs them). When the subject is ready to proceed with the survey, the computer displays the first scale on its screen. Using the computer’s mouse, the subject moves a pointer along the scale and registers a judgment with a simple click of the mouse button. This causes the next scale to automatically appear. Presentation of scales is superior to the usual paper survey because the computer selects the

Figure 2: 1987 survey results representing the “ideal station wagon” stereotype. The computer arranges scales from top to bottom in order of their usefulness to the designer. The most useful scales have more extreme means (judgements of 1 or 7 are more meaningful than 4s) and smaller standard deviations (greater consensus).



word pairs randomly and randomly switches their left-right order to mitigate bias effects in accordance with principles of good survey design ("fast-slow" is just as likely to appear as "slow-fast").

At any point in the survey, the designer can invoke the "Survey Analyzer" module to statistically analyze the data and illustrate them graphically, as shown in Figures 1-3. Figures 1 and 2 show results of surveys of ideal 4-door sedan and ideal station wagon stereotypes conducted in conjunction with my Fall, 1987 automotive design class, which was preparing to design sedan wagon variants of the same basic car. Thirty university students between the ages of 18 and 27 participated in the sedan survey (16 males and 14 females). Thirty-five students between 18 and 27 participated in the station wagon survey (25 males and ten females).

Subjects were not considering actual sedans or wagons, only imaginary ones. Although most of the subjects were automotive design students, and may have conjured quite specific images of their own designs, the imaginary nature of the concepts nevertheless would assure that they would be relatively abstract—more so than if they were looking at actual cars, illustrations or models. The surveys were aimed at defining ideal stereotypes, qualities which came to mind when contemplating 4-door sedans and station wagons as they should be. This differs from an existing stereotype which purports to represent meanings associated with things as they are.

The computer sorts the results and lists the scales from top to bottom in the order of their importance and usefulness in determining design strategies. The computer looks for two things when ranking scales: how close the means (represented by the white diamonds) are to either end of the scale (judgments of 1 or 7 are more important than 4's); and the consensus of the subjects. (Other weighting factors will be incorporated into the formula later.) Consensus is indicated by the lengths of the shaded bars. Each bar represents one standard deviation on either side of the mean. Statistically, it can be assumed that approximately two-thirds of the subjects' responses will lie within one standard deviation of the mean. The shorter the bar (or standard deviation), the greater the consensus; the longer the bar, the less the consensus.

According to the results, expectations are so high that a 4-door sedan should be "smooth" and "fast," that a designer would be foolish to design one that seemed "rough" and "slow." The feminine-masculine scale, on the other hand, is relatively unimportant in either the sedan or wagon case because means for both are on or near the neutral midline. We can draw two conclusions from this. First,

there is no particular aesthetic potential in making either body type seem definitely masculine or feminine. By the same token, however, the designer is free to make them either masculine or feminine without dire consequences. We could draw the same conclusions if judgments varied randomly from 1 to 7, resulting in large standard deviations that spanned the entire scale.

Semantic Distance or Image Differentiation

Other useful information can be gleaned by comparing the results of two surveys. Generally, the results shown here suggest that "sedan" is a more potent or energetic concept than "wagon." We know this by noting that adjectives on the right-hand side of the graph are all more highly correlated with notions of power and activity than their opposites on the left, and that sedan judgments lie further to the right on most scales than wagon judgments. In those notable cases where the difference exceeds 0.5, the sedan is perceived as faster, sharper and more active than the wagon. It is also thought of as more emotional and ferocious. The wagon is more potent than the sedan on only four scales: It is rougher (not as smooth), stronger, heavier, and more accidental (less controlled).

This tells the designer who is developing a station wagon variant of a sedan that it should seem relatively stronger and heavier than its sedan counterpart. It also says that, if the result isn't quite as smooth or controlled as the basic sedan, it's okay—witness the relative clutter of the Taurus wagon's roof rack, compared to the sedan's clean roof, and the abrupt discontinuity of the wagon's beltline at the rearmost door cut.

Aesthetic Potential

Comparisons of ideal and existing stereotypes yield measures of aesthetic potential—indications of pent-up "demand," if you will—for specific meaning which the designer can use in developing design strategies. A survey of "the typical four-door sedan," for instance, might yield a mean of 3.0 on the ordered-chaotic scale. Compared with the more extreme 2.4 of the ideal stereotype, this would mean that sedans currently on the streets are less than ideal in this regard and that consumers (represented by the particular group participating in the two surveys) would be receptive to a sedan with a considerably more ordered look.

Trends

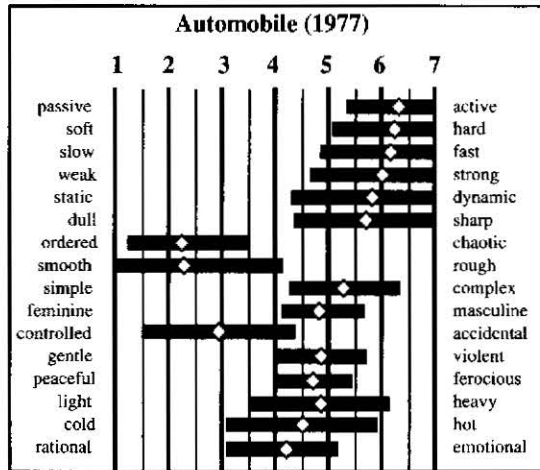
Comparisons of stereotypes developed at different times yield measures of potential trends. Consider, for example, a comparison of the ideal 4-door sedan stereotype with an automobile stereotype (Figure 3) developed from a survey of 23 male industrial design students at the Center for Creative Studies in 1977. (Although I didn't collect it,

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Figure 3: 1977 survey results representing the "automobile" stereotype. Not only do judgements on individual scales differ from those of a similar survey done ten years later (Figure 1), but the relative importance of scales differ.



age data would be similar to the 1987 surveys.) The comparison is not ideal because the concept names were not identical. Although the subjects were preparing to design a 4-door sedan (and I presumed they had that in mind), notions of sports cars and station wagons may have affected their judgments, as well. Nor were they instructed to think specifically of typical or ideal cases.

Nevertheless, for purposes of demonstration, let's consider the sudden impetus for design change—and change in taste—provided by the energy crises of the 1970s and the effects they might have had on stereotypes then and now. We should see shifts consistent with downsizing of cars and increased aerodynamic efficiency. Indeed, there was a shift from heavy (in 1977) to light (in 1987), perhaps as the public learned to appreciate smaller (lighter) cars for their fuel efficiency. Judgments also went from complex to simple, from hard to soft, from masculine to feminine, closer to smooth and away from sharp—just as we would expect if tastes for the straight-lined, crisped-edged boxes of the '70s have given way to affection for the voluptuous curves, flush surfaces and soft edges of the late '80s' "jelly-beans." Although the 1987 surveys yielded only a slightly more extreme judgment toward smooth than the earlier survey, the importance of smoothness, a prime mark of good streamlining, became paramount in the case of the ideal 4-door sedan, jumping from the middle to the top of the graph.

Subjective Concinnity

The computer can calculate the subjective concinnity of a particular product design by comparing surveys of it and its relevant stereotype. A survey of the ideal telephone, for instance, would be compared with a survey of an actual model or prototype of a proposed telephone. The

same subjects could be used for both surveys; if not, subjects should at least be drawn from the same market segment being targeted by the product. (For more information on the concept of concinnity, see references 6-9.)

The computer calculates a dimensionless coefficient from 0 to 1.0 which measures the semantic distance between the ideal and real concepts along a line, in effect, through a three-dimensional semantic space. If the concepts are close together (high subjective concinnity), the proposed design will be compatible in the classic sense defined in the human factors literature. The proposed design will tend to meet all expectations. It will not seem novel or unusual and, thus, will not offend the intended consumer. Neither will it stir the emotions in ways that create much eye-grabbing, heart-pounding appeal.

The greater the semantic distance between a product and its stereotype, the greater its aesthetic potential (its ability to stir the viewers' feelings). Unfortunately, aesthetic potential is a double-edged sword. A product displaced in one direction away from its stereotype will evoke pleasant excitement, which attracts the viewer. But displaced in the opposite direction on this line through the semantic space, the product will provoke uneasiness, which the viewer would rather avoid. The computer sorts things out and suggests to the designer how to optimally balance aesthetic potential and subjective concinnity for the best results.

Computation of a product design's objective concinnity requires an analysis of the design's geometry which is beyond the scope of this software. However, the software can provide an estimate of relative objective concinnity based on the fact that certain scales of the semantic differential (ordered-chaotic, for instance) are highly correlated with objective concinnity.

Future Developments

Apple has announced plans to introduce a lap-top portable version of the Macintosh within a year. That machine should extend the utility of the software dramatically by making field surveys much more practical.

Future versions of the software will include an "Advisor" module, based on expert system technology, which will more actively help the designer to develop strategies for improving a design. Eventually, I expect to tie this module to computer-aided design software so that the computer can try fixes to the product's geometry automatically in order to optimize its semantics.