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Aesthetics in Design

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Aesthetics in Design

Abstract

The aesthetic response to an artifact is the immediate feelings evoked when experiencing that artifact via the sensory system. I consider aesthetic responses to be different from other cognitive responses in at least three ways. Aesthetic response is rapid, usually within seconds of exposure to the artifact. Aesthetic response is involuntary, requiring little if any expenditure of cognitive effort. Aesthetic response is an aggregate assessment biased either positively (e.g, beauty or attraction) or negatively (e.g., ugliness or repulsion) and not a nuanced multi-dimensional evaluation.

Disciplines
Management Sciences and Quantitative Methods

DESIGN

creation of artifacts in society

Karl T. Ulrich

Contents

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FIVE

Aesthetics in Design

The aesthetic response to an artifact is the immediate feelings evoked when experiencing that artifact via the sensory system. I consider aesthetic responses to be different from other cognitive responses in at least three ways. Aesthetic response is *rapid*, usually within seconds of exposure to the artifact. Aesthetic response is *involuntary*, requiring little if any expenditure of cognitive effort. Aesthetic response is an *aggregate assessment* biased either positively (e.g, beauty or attraction) or negatively (e.g., ugliness or repulsion) and not a nuanced multi-dimensional evaluation.

For example, consider a brochure for a new financial service, say a mutual fund. The graphic design of the cover of the brochure may evoke an aesthetic response— an immediate, involuntary sense of attraction— but the prospectus detailing the securities held in the mutual fund is not likely to do so. While the service may be quite appealing and preferred over other alternatives, this assessment of preference is likely the result of a deliberate analytical process over an extended time period and will probably include a balancing of elements of like and dislike. The response to the prospectus takes significant time, requires effort, and it is multidimensional, and so for my purposes is not an aesthetic response.

Aesthetic response is most frequently stimulated by visual information, largely because the vision system provides data more immediately and at higher rates than do the other senses. Nevertheless, aesthetic responses can be stimulated via senses other than vision. For example, consider the response to the sound of a recording of Aretha Franklin; the feel of a warm whirlpool; the taste of a chocolate truffle; the smell of spoiled meat; the acceleration of a rollercoaster in a sharp turn.

We typically think of the aesthetics of an artifact as distinct from its function. Two different hammers might perform the task of driving nails

equally well and yet they may evoke different aesthetic responses in the user. Why then do aesthetics matter in design?

Let me cite three reasons, giving a preview of a theory of aesthetics to follow. All other things equal, most users will prefer a beautiful artifact to an ugly artifact, even in highly functional domains such as scientific instruments. Thus, beauty can be thought of as "just another attribute" in a user's evaluation of preference, alongside durability, ease of use, cost, and safety. In this respect, the aesthetic quality of an artifact is an important factor in providing a satisfying user experience, the prime motive for design.

Second, the aesthetic response to an artifact is usually the *first* response to the artifact. First impressions matter, and overcoming an initial aesthetic repulsion is a substantial challenge for the designer, better avoided in the first place.

Third, beauty may serve as a signal for unobservable attributes of quality, much as a brand does for products and services. In such cases, beauty itself is less important than what else the observer may infer from an exhibition of beauty.

So far I have avoided the question of why one artifact may be perceived as more beautiful than another. This question has been posed more generally for centuries by philosophers attempting to explain beauty across the domains of art, literature, music, landscapes, architecture, and the human body. Eighteenth-Century philosophers David Hume and Immanuel Kant (Gracyk, 2003) wrote about aesthetics and engaged the fundamental question of the extent to which aesthetic quality is absolute and universal or dependent on context. Although the philosophy and psychology of aesthetic judgments is more nuanced today, this basic tension between universal standards and relative assessment remains prominent. I believe that the most grounded theory of universal aesthetic judgment derives from evolutionary psychology, and I review that perspective here. I then discuss the perspective that aesthetic judgments are derived from specific human experience and cultural context. After providing a brief review of these two perspectives, I synthesize them into the beginnings of a theory of aesthetics for design. Finally, I turn to the problem of how to design beautiful artifacts.

Evolutionary Aesthetics

Most significant human adaptations evolved over the past 100,000 generations (2-3 million years) and so haven't changed much since the dawn of modern civilization. This fact has led to the observation that we live in a modern world, but are equipped with a stone-age mind.

The evolutionary perspective is that aesthetic responses must have provided reproductive advantage to our ancestors, or as summarized more formally by Thornill (2003):

"Beauty is the moving experience associated with information processing by aesthetic judgment adaptations when they perceive information of evolutionary historical promise of high reproductive success."

The classic example of evolutionary aesthetics is that humans on average find symmetry attractive in potential mates. And in fact, even today, facial symmetry is correlated with reproductive health, and so it is plausible that rapidly detecting and being attracted to facial symmetry is an aesthetic judgment adaptation that could have led to relatively higher reproductive success (Thornhill and Gangestad 1993). Evolutionary aesthetics also convincingly explains a wide range of other responses, including an aversion to slithering snake-like objects and a preference for landscapes that provide protection and vantage points. A central tenet of evolutionary aesthetics is that adaptations are shared by essentially the entire species and so to the extent that an adaptation explains an aesthetic response, it does so universally. (See Dutton (2003) for a nice summary of the key ideas in evolutionary aesthetics.)

On balance, I find quite compelling the idea that we possess many specific cognitive adaptations for quickly assessing attractive and repulsive properties of the physical world and that some of these adaptations are likely to be relevant to aesthetic judgments of artifacts. However, the evolutionary perspective can not yet explain a great many of the interesting characteristics of aesthetic responses exhibited in society today.

Cultural Aesthetics

The evidence is overwhelming that many aesthetic judgments differ widely across time and across cultures. As a result, anthropologists and psychologists have sought cultural explanations for aesthetic judgments.

The cultural perspective on aesthetics posits that the ideas prevalent in a social environment influence the aesthetic preferences of individuals within that environment. Therefore, when the environment differs, so do the aesthetic preferences.

One manifestation of cultural phenomena is the emergence of *schools* of design or *design movements*. Perhaps the most influential school of industrial design was the Bauhaus formed by Walter Gropius in Germany in 1919. The central tenet of the Bauhaus was that good design arises from the seamless integration of art and craft. Gropius articulated a set of design principles including "organically creating objects according to their own inherent laws, without any embellishment or romantic flourishes." One of the most famous designers to emerge from the Bauhaus was Marcel Breuer whose bookcase from 1931 is shown in Exhibit BAUHAUS. Although the Bauhaus survived less than 15 years, the aesthetic style of functional minimalism is still today broadly influential.

Exhibit BAUHAUS. Bookcase c1931 by Marcel Breuer, a student and teacher at the Bauhaus school.

The Memphis movement was formed in 1981 as a consortium of Italian designers led by Ettore Sottsass. The movement was essentially a reaction against modernism, which was to a large extent an outgrowth of the Bauhaus. The Memphis designers produced whimsical, colorful, and even illogical artifacts. An example of Sottsass's work within Memphis, another bookcase, is shown in Exhibit MEMPHIS.

Exhibit MEMPHIS. The Carlton bookcase c1981 by Ettore Sottsass the founder of the Memphis group.
(http://boijmans.medialab.nl/onderw/genre/indvrmg/iv3b.htm)

A theory of aesthetics that seeks to explain the aesthetic appeal of both the Bauhaus and Memphis bookcases seems likely to require cultural insights, in addition to the evolutionary perspective. Despite their apparent differences, the evolutionary and cultural perspectives are not mutually exclusive explanations for aesthetics. In fact, they can be harmonized in a relatively straightforward way as follows.

All aesthetic judgments are cognitive. Cognitive mechanisms are implemented by a biological system that is a collection of evolutionary adaptations. Some fundamental cognitive mechanisms are largely invariant across humankind regardless of education, culture, or experience. However, many cognitive mechanisms, even if invariant across the species, operate on *symbols* and not on minimally processed sensory inputs, and the values of the symbols on which the cognitive mechanisms operate may vary widely. Also, many cognitive mechanisms are developed, or at least tuned, in a particular individual based on learning and experience.

For example, cognitive mechanisms for determining status, prestige, and rank appear to be quite universal, but operate on symbols whose values depend on context. In one setting the symbols associated with status may be derived from body piercing and in another from a large automobile. Although, at this time, the explanatory power of evolutionary aesthetics is relatively weak for settings in which aesthetic response is highly dependent on social environment, learning, and culture, by recognizing that cognitive mechanisms may produce very different aesthetic responses depending on the context, both the evolutionary and the cultural theories of aesthetics can be useful and harmonious.

A Theory of Aesthetics in Design

Despite the ambitious section heading, let me state clearly from the outset that I do not have a fully formed and comprehensive theory of aesthetics in design. Nevertheless, I offer some fragments of a theory, which I do think are useful in providing insights and in guiding practice.

The theory is comprised of these elements:

- The phenomena we lump together into *aesthetic response* are actually the result of many different cognitive mechanisms.

- These cognitive mechanisms operate on basic sensory inputs and on symbols derived from these inputs and from memory.

- The cognitive mechanisms that we consider aesthetic have short time constants and may be superseded by a more deliberate formation of preference based on analysis over longer time periods.

- Some important and significant aesthetic responses are vestigial adaptations for detecting physical features that were useful in an evolutionary sense.

- Other important and significant aesthetic responses are adaptations that operate on symbols derived from learning, experience, and cultural context.

Consider Exhibit RESPONSE, which is a schematic representation of the theory. We perceive an artifact through a sensory interface. Many cognitive processes operate simultaneously. Some are extremely rapid, detecting light and motion, for example. Others play out over a second or longer, like those detecting shape, symmetry, gloss, and temperature. Cognitive processes continue to operate and may invoke symbols from memory. Finally, aesthetic responses may give rise to deliberate analytical thought which may persist over minutes or longer. An overall preference may be formed within a fraction of a second, but this preference may change as additional information is processed. An initial positive impression may wane, or an initial aversion may turn positive.

It is now apparent that within this theory a sharp distinction between an aesthetic response and an analytical response is a somewhat arbitrary conceptual convenience. The boundary between aesthetics and analytics can not be sharply drawn. However, I do think that judgments that play out over a few seconds feel qualitatively different from those that may play out in minutes, and certainly from those that operate intermittently over hours and days.

This theory also lets us distinguish between responses that are likely to be universal and those that are likely to be highly dependent on symbols determined from learning, experience, and culture. The most immediate responses are those that are derived from the information processing mechanisms closely tied into the sensory system. Those mechanisms that rely on retrieving symbols from memory are likely to require more time.

Within this overarching theory, let me make five propositions which I think can be useful in explaining aesthetics in design and in guiding practice. Certainly these propositions are incomplete and are yet to be validated empirically. With this disclaimer, here they are.
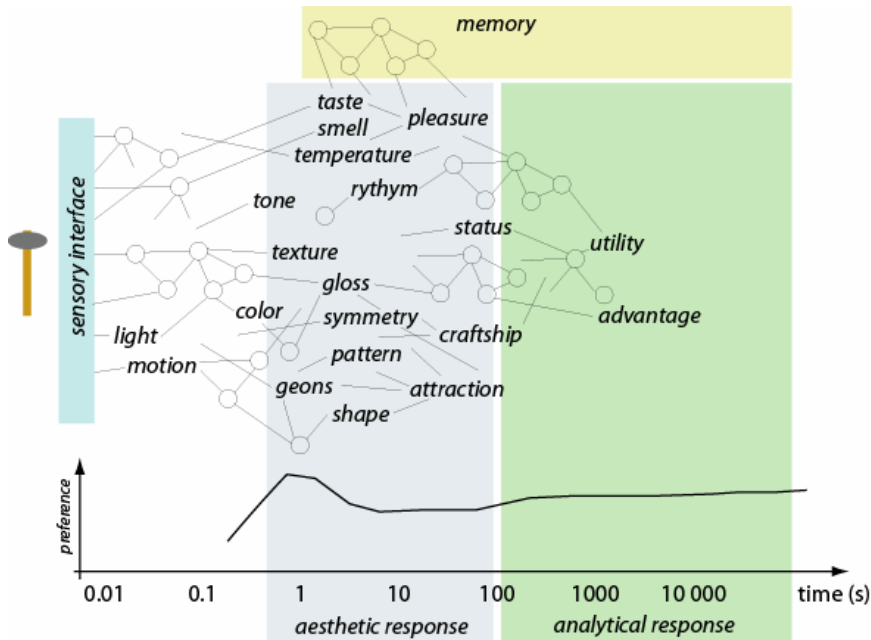
Exhibit RESPONSE. Schematic illustration of human cognitive response to an artifact.

First Impressions Matter

Aesthetic responses are immediate and involuntary and they result in the development of preferences. I conjecture that aesthetic responses influence subsequent analytical determination of preference and that specifically, a positive aesthetic response is more likely to lead to a positive ultimate preference, than if the initial aesthetic response were negative[1]. Such a phenomenon could be exhibited for at least three reasons. First, and obviously, beauty itself is by definition preferred and so given similar analytical preferences, the beautiful artifact should still be preferred over the ugly artifact. Second, and more subtly, an initially positive aesthetic response may result in a greater chance of further analysis and exploration by the user. A negative aesthetic response may dissuade the user from ever learning more about the artifact and therefore reduces the chance that an ugly, but otherwise preferred, artifact will ever be fully evaluated. Third, I suspect that aesthetic preferences are "sticky." That is, positive aesthetic judgments create a posi-

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[1] Coates (2003) provides a nice discussion of a version of this idea in his work on "liking and disliking" products.

tive bias that persists even in the face of mounting negative analytical evidence. Conversely, negative aesthetic judgments persist even when further analysis reveals highly positive attributes.

The first-impressions proposition could be tested experimentally by providing information about artifacts to human subjects in different sequences and testing whether information relative to aesthetic judgment (e.g., appearance) has a stronger influence on preference when it is presented first than when it is presented after information relative to analytical judgments.

Vestigial Adaptations Contribute to First Impressions

There were no cell phones in our evolutionary past, and yet when we see a cell phone, our stone-age sensory system and aesthetic adaptations will be involuntarily invoked. We are not able to command our retinas and visual cortex to evaluate a cell phone differently than it would a stone hand ax. I propose that for most modern artifacts, our most immediate aesthetic responses are vestigial; that is, they are the result of adaptations that were useful in our evolutionary past, but that these adaptations when applied to modern artifacts do not today confer reproductive advantage. If true, this phenomenon does not make the aesthetic response any less real or any less powerful in determining ultimate preference, and so understanding these vestigial adaptations may be usefully exploited in creating artifacts that are attractive.

As far as I know, there are no comprehensive catalogs of vestigial aesthetic adaptations. However, a few adaptations have been clearly articulated and fewer still have been convincingly established empirically. Here I describe two: gloss and cuteness.

Before I provide these examples, let me emphasize what I am *not* claiming. By arguing that there are fundamental vestigial aesthetic adaptations, I am not arguing that these adaptations are always paramount in determining aesthetic preferences. My theory posits that there are hundreds of information processing mechanisms that determine aesthetic response, and that some of these operate on symbols drawn from memory. An immediate vestigial response based on fundamental physical attributes of the artifact such as shape or surface finish could be quickly superseded by a response derived from what those attributes mean to the observer symbolically.

Exhibit GLOSS is a consumer electronic device, the iPod portable music player created by product designers at Apple Computer. Most people find it very attractive. Many explanations are possible, but one element of its attraction is that it is *glossy*. How could the surface finish of an engineered component invoke a vestigial aesthetic response? Coss and coworkers have argued that our brains are hardwired to love reflective surfaces because the only reflective material on the savanna in the Pleistocene was *water*, and water was a scarce and highly valuable substance (Coss and Moore 1990). They further showed that infants will pick up and lick glossy objects more frequently than the same forms with matte surfaces. To me, it is highly plausible that humans possess cognitive mechanisms for detecting and rewarding the detection of glossy surfaces, and that these mechanisms are quite fundamental.

Exhibit VW. Why is this car cute?

Physics can be Aesthetic

I believe that humans possess fast and effective *physics computers*. We are remarkably good at estimating trajectories, predicting imbalance, and sensing strength and rigidity of structures. One can easily imagine why such cognitive mechanisms would have been useful in an evolutionary sense. Consider Exhibit GRANDCANYON, which shows a proposed walkway over the Grand Canyon. How attractive do you find this walkway? Personally, I want to turn and run back to the mini van. My physics computer does not understand tricky high-strength steel cantilevered structures, and its immediate reaction is that this is an artifact to be avoided.

Exhibit GLOSS. We like glossy objects, perhaps because of hard-wired attraction to water.

Exhibit VW is a early Volkswagen Beetle automobile. Is there anyone who doesn't immediately find this car cute? How can a car be cute? Why do we like cute inanimate objects? We don't need much imagination to create a theory of cuteness. Babies exhibit certain physical features such as forward facing eyes and rounded heads and these features are attractive to adults who can provide resources and protection for the young. The cute phenomenon could have plausibly evolved to provide reproductive advantage to humans. So powerful are cute features in invoking attraction, that our cognitive mechanisms are tricked into oohing and ahhing over collections of sheet metal that resemble babies.

This is an interesting example of where an initial aesthetic revulsion might be superseded by a higher-order preference. If I thought about the walkway for a few minutes, I would probably conclude that thousands of people had safely walked on it and that the chances of it falling down as I walked on it were pretty slight, probably less than the chances of being hit by a tour bus as I headed across the parking lot. At that point, I might actually be attracted to doing something that stimulates my danger avoidance system, an opportunity I don't have very often as a university professor. Nevertheless, I think designers benefit from understanding that humans are likely to be attracted to things that appear safe and stable, and that this perception is based on the physics of pretty ordinary objects made of materials like tree branches and rocks.

Exhibit GRANDCANYON. Proposed cantilevered walkway over Grand Canyon. What is your aesthetic response? What is your mental physics processor telling you?

Aesthetic Features are Honest Signals of Quality

Signals are essential elements of our means of making sense of the world[2]. We use signals to detect whether someone is bored with a joke, to decide whether to stop at a road-side restaurant, and to choose a sofa for the living

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[2] Meaning in design is closely linked to aesthetics. The broader issue of what artifacts mean and how they communicate meaning is the focus of the intellectual area of design semantics (Krippendorff, 2006), and has been treated in the marketing community as well (Solomon 1983).

room. The concept of an *honest signal* arises in both evolutionary biology and in economics, and I believe plays a key role in aesthetics. An honest signal is one that is unlikely to be faked by the signaler and therefore can be relied on by the receiver of the signal. In nature, the vertical jumping of a gazelle when encountering a lion is an honest signal that the gazelle is fit and can outrun the lion. This is mutually beneficial because the animals can effectively skip the expense of a contest with a predetermined outcome; the gazelle doesn't actually have to run and the lion doesn't actually have to chase. In economic life, agents develop behaviors in response to incentives, and signaling is an important element of this behavior. Spence (19XX) showed that an overinvestment in education, say by attending a challenging university is like the gazelle's leap. The action is a signal of professional ability that can be relied upon by an employer. Nelson showed that under certain conditions advertising by a manufacturer can be viewed as an honest signal of product quality (1973).

In order to be *honest*, a signal must be difficult or costly to fake. In economic terms, it must provide more net benefit (benefit minus cost) for a more fit signaler than it does for a less fit signaler. Under these conditions, it is in the fit signaler's interest to provide the signal and the receiver can therefore rely on the signal as a true indicator of fitness.

Mithen (2003) has done a fascinating study of ancient hand axes, possibly the first aesthetic artifacts. Apparently, our ancestors developed an aesthetic preference for highly symmetric, carefully crafted stone hand axes. The leading theory of this aesthetic preference is that beautiful hand axes were honest signals of male fitness. A male who could be directly observed to craft a beautiful hand ax was one who (1) had access to scarce resources like obsidian, (2) had excellent strength, dexterity, and fine motor skills, and (3) could afford to sit and make axes for hours at a time and still survive. The signal is honest in that it is less costly for a fit fabricator to make axes than a less fit fabricator, and so the expenditure of effort to fabricate aesthetic hand axes can be relied on as a signal of fitness.

In an analogous way, deliberate investment in designing aesthetically pleasing artifacts can be used by producers and consumers as an honest signal of the quality of the artifact. The key idea is that designing beautiful artifacts is costly for a producer. If an artifact is beautiful, it is unlikely it got that way by accident or by trivial imitation. Rather, a designer devoted care and attention to the forms, surfaces, and details of the artifact. In a profit

maximizing setting, the producer who stands to benefit the most from this investment is the one who produces goods that are preferred upon closer inspection and that will deliver long-term satisfaction to the user. In this way, the producer of better products benefits more from positive aesthetics than does the producer of lower quality products. Thus the development of aesthetic features of artifacts satisfies the requirements of honest signaling.

Artifacts have Symbolic Value in Social Systems

Teenagers seem able within seconds to size up a fashion accessory and determine whether it is attractive or not. The aesthetics of fashion are highly dynamic, and so it is hard to argue that some intrinsic physical properties of fashion accessories directly determine aesthetic preference. Rather, fashion artifacts must stimulate and invoke symbols in memory that determine the aesthetic response. I am not ambitious enough to try to explain fully such mechanisms, but let me conjecture how one such mechanism might work.

Exhibit 50CENT shows the hip hop artist 50 Cent wearing huge jewel-studded items of jewelry known (as I write this anyway) as "bling." My teenage-year-old son has a strongly positive aesthetic response to bling. Personally, I don't get it. Indeed, the fact that I don't get it may be a key reason my son likes it. A simple set of symbolic relationships seem highly predictive of his aesthetic response: An artifact whose physical attributes (1) invoke an association with a group a teenager admires and (2) invoke a disassociation with the parents, will be attractive to the teenager.

Lest I dismiss this response as youthful folly, an almost identical mechanism explains in part why I am attracted to Patagonia brand apparel. I aspire to the dirt bag, free spirited culture associated with the brand, and wish to disassociate myself from the Ralph Lauren set. This is such a primitive symbolic aesthetic response that it persists despite the logical analysis that the more accurate association of Patagonia would be with middle aged, affluent, wannabe professionals. True dirt bag nomads buy their fleece at Walmart or Goodwill.

It is easy to imagine other symbolic relationships that could explain aesthetic responses. Most of these relationships operate on symbols whose values are themselves dynamic. A few relatively straightforward relationships could give rise to phenomena that appear complex and dynamic, such as fashion in current society. One such simple mechanism is explored as an economic model by Pesendorfer (1995). I suspect many others are possible.

Exhibit 50CENT. The hip hop artist 50 Cent wearing his bling. (source: http://www.virgin.net/music/wallpapers/images/50cent_1024.jpg)

Creating Beautiful Artifacts

Even assuming you are persuaded by my proposed theory of aesthetics of artifacts, I have provided no prescriptions for how one might actually design beautiful artifacts.

We can certainly imagine a design process which can create beautiful artifacts, although perhaps not efficiently. Such a process requires only that we can generate alternatives and that we can evaluate the beauty of those alternatives. In Chapter Two, I discuss exploration in detail, but no great intellectual leap of faith is required to imagine a way to generate alternatives. One could engage a variety of different designers with different approaches, each of whom would generate different designs. One can also imagine a simple, even if costly, approach to evaluation. We could simply build prototypes of the alternatives, present them to the target user population, and observe which are preferred by the users. In fact, at the macro level of an entire industry or design domain, this is the process by which artifacts may become more attractive over time.

However, an unguided process of generating alternatives and evaluating them through testing in a user population is inefficient. Given a theory of aesthetics a designer should be able to develop and apply heuristics based on causal relationships in the theory, resulting in the generation of more successful alternatives and a reduced requirement for testing. An example heuristic is that all else equal, humans assume "normal phyics" in evaluating objects, so chairs, tables, and other structural objects are more likely to be attractive if their forms appear to be stable, solid, and strong.

I believe that developing a more complete theory of aesthetics in design is possible. With such a theory, I believe that useful design heuristics could be developed that would be highly effective in educating designers and in guiding practice. About thirty years ago, the architect Christopher Alexander and his collaborators wrote a brilliant book, *A Pattern Language* (Alexander et al., 1977), which is essentially a collection of heuristics for designing the built environment, some of which are based on thoughtful and careful observation of how humans respond to their buildings and outdoor spaces. Alexander's heuristics are surprisingly easy to apply, and have attracted a passionate following among some designers. For example, Alexander's heuristic (or "pattern") 159 is:

"When they have a choice, people will always gravitate to those rooms which have light on two sides, and leave the rooms which are lit only from one side unused and empty" (Alexander 1977, p.747).

He goes on to articulate the theory underlying this heuristic, which is in part that light from two sides provides the optimal illumination of other people for detecting subtle expressions and movements, making the rooms conducive to understanding social exchanges.

While expert architects may over a long career develop strong intuition about natural lighting, a heuristic like Pattern 159 is highly useful in guiding a novice.

Practical Aesthetics

As an academic, I am optimistic and intrigued by the prospect for a comprehensive theory of aesthetics, which might then be followed by the development of useful heuristics for design. However, as a designer, I know that we are probably decades away from that goal. As a practical matter, heuristics for aesthetics are likely to be of limited use. Rather, we will continue to rely on designers who possess skills, largely tacit, for creating beautiful artifacts.

Design spaces are *rugged*, in the sense developed in Chapter Two, meaning that incremental iterative improvement of a design is unlikely to result in finding a great solution. Better solutions are likely to be found in territory distant from the starting point. In such environments, we know that parallel exploration using divergent approaches is likely to result in better outcomes. As a result, competitions, parallel exploration by members of a design team, and the application of distinct methods for creating alternatives, are likely to be useful exploration strategies.

A substantial problem for designing artifacts that are strongly preferred overall, is that the people who are skilled at designing beautiful artifacts may not be those skilled at designing artifacts to achieve other more purely functional objectives. One need only spend a few hours in a studio in an industrial design program and then in an engineering lab to realize that the cognitive processes, social systems, and skills and capabilities of these two populations are nearly disjoint.

Nevertheless, at a macro level, the design process is the same. Designers consider a gap, explore alternatives, evaluate alternatives, and iterate. An organizational challenge is to coordinate the exploration and evaluation of alternatives with contributions from individuals who are very different in order to arrive at a design that stands out on many dimensions.

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