ESSAYS ON SCIENCE AND SOCIETY

Creative Sparks

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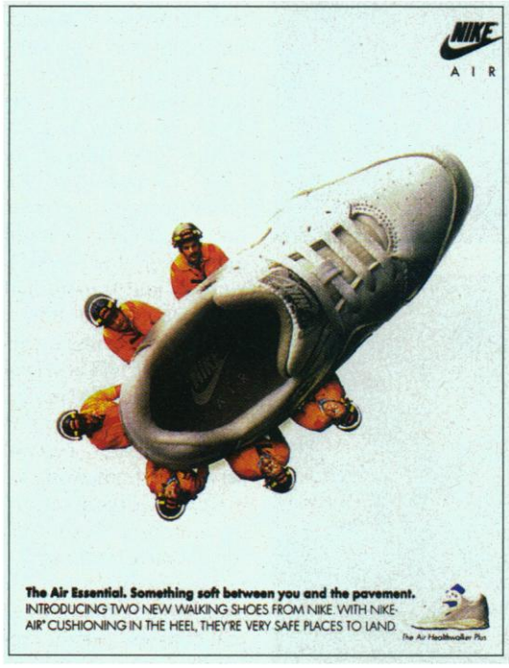
Imagine you found out that ideas invented by a computer were rated higher by independent experts than ideas created by a group of humans asked to perform the same task. Would you praise the designer of the "creative computer" for a great achievement or would you question why human talent—usually so potent in coping with complex cognitive challenges—created such poor ideas? Or maybe you would question your view of the notion of creativity. In fact, such a scenario was played out when we used a simple computerized routine to generate ideas and compared them with ideas invented by human subjects. Why did human judges perceive the computer's outcomes as superior to human ideas when they performed the same task?

Creativity is considered the ultimate human activity, a highly complex process, difficult to formalize and to control. Although there is a general agreement regarding the distinctive nature of the creative product (idea, painting, poem, and so on), there is a controversy over the nature of the creative process. Some researchers hold that the creative thinking process is qualitatively different from "ordinary" day-to-day thinking (*1–4*), and involves a leap that cannot be formulated, analyzed, or reconstructed—the creative spark. Others adopt a reductionist view that creative products are the outcome of ordinary thinking, only quantitatively different from everyday thinking (*5, 6*).

Because creative ideas are different from those that normally arise, people often believe that such ideas require conditions dramatically different from the usual. The notion goes that, in order to overcome mental barriers and reach creative ideas, total freedom is necessary—no directional guidance, constraints, criticism, or thinking within bounded scope (*7*). Then ideas can be drawn and contemplated from an infinite space during the creativity process (*2, 8, 9*). This view prompted the emergence of various idea-generating methods: brainstorming, synectics, lateral thinking, random stimulation, and so on, all of which consist of withholding judgment and relying on analogies from other members in the group or on randomly selected analogies (*10*). This family of methods relies on the assumption that enhancing randomness, breaking rules and paradigms, and generating anarchy of thought increase the probability of creative idea emergence.

Do these methods work? A number of researchers indicate that they do not (*5, 11–15*). Ideas suggested by individuals working alone are superior to ideas suggested in brainstorming sessions and the performance of problem solvers instructed to "break the rules, get out of the square, and change paradigms" was not better than that of individuals who were not given any instructions at all.



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The failure of these methods to improve creative outcomes has been explained by the unstructured nature of the task. Reitman (*16*) observed that many problems that lack a structuring framework are ill-defined in that the representations of one or more of the basic components—the initial state, the operators and constraints, and the goal—are seriously incomplete, and the search space is exceedingly large. Indeed, many ill-defined problems seem difficult, not because we are swamped by the enormous number of alternative possibilities, but because we have trouble thinking even of one idea worth pursuing.

In fact, cognitive psychology studies indicate that the detection and use of rules during the generation of ideas may even result in enhanced surprisingness (a dimension of creativity). For example, according to Perkins (*6*), adherence to a cognitive frame of reference involves sensitivity to the "rules of the game" and, by functioning within a frame, one achieves a better position from which to notice or recognize the unexpected. The postulated association between creativity and total freedom is challenged also by recent findings in advertising research, an area in which creativity is central. Certain regularities underlie successful ads, and those that match some of these regularities stand out as more creative than ads that do not fit these structures. In a survey of ads, 89% of the award-winning ads contained one of six regularities, or "creativity templates." Of these, about 25% could be schematically depicted as a simple template termed "Replacement."

In the Replacement template, the creative process is as follows: Given a product (*P*) with a trait (*T*), the subject is asked to come up with a creative idea for an ad that conveys the message that *P* has *T*. In a visual format, an object *S* (symbol), which is universally identified with *T*, is replaced with *P*. The effect is enhanced if *S* is placed in a situation in which *T* is essential. Moreover, the replacement operation can be iterated: Rather than *P*, one can use parts of it, or aspects of it, or objects associated with it, to replace the corresponding elements associated with *S* (*17, 18*).

An example can make this clearer. In the advertisement for Nike-Air shoes (at left), the shoe has the trait (*T*) of "cushioning and absorbing the shocks" caused by sports activities (*19*). This ad shows a group of firemen holding a shoe, which has replaced the life net for fire victims escaping from a burning building. The Replacement template is followed when a product *P* (athletic shoe) or one of its aspects (shape) replaces the corresponding aspect of *S* (life net) in a situation where its trait (*T*) ("cushioning/absorbing shocks") is crucial (saving leaping victims). The aspect substitution can be represented by a link between *P* and *S*. This link is in general different from a simple pictorial metaphor, because the substitution may lead to a new entity, which often does not exist in the real world.

The general scheme of the algorithm can be illustrated by a sequence of four elementary operators: *Split* in which a com-

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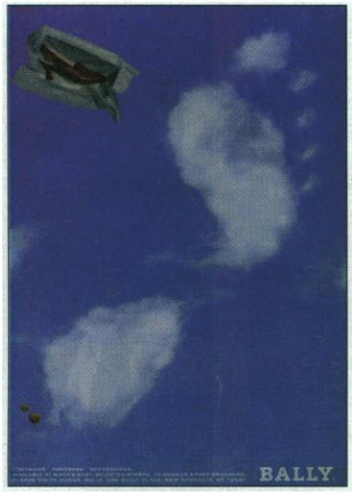
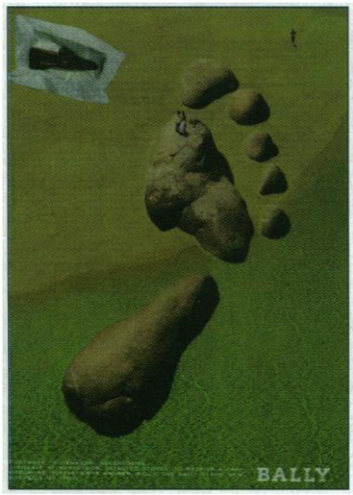
ponent is detached, *Exclude,* which removes an attribute or a component (the fireman's life net is excluded from the rescue situation); *Include,* in which a new element *S* is introduced into the environment (a Nike-Air shoe is added to the rescue); and *Link,* the linking operator substitutes the excluded component for another (the shoe replaces the net).

The Replacement structure also underlies the Bally shoe ads (*20*, at right). The advertisements associate the shoe with a sense of freedom by replacing the contour of an island or clouds (symbols of freedom) with the shape of a foot. Although at first glance it may appear remote, the ad creative concept for Bally shoes has the same fundamental scheme as the Nike-Air athletic shoe ads.





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Because a template consists of a sequence of well-defined and first-principle operations, an algorithm can be defined that can produce ad ideas systematically. We constructed such an algorithm and presented the ideas generated by this computerized routine to judges, along with ideas on the same theme appearing in ads that had won creativity competitions, ads that had been published in leading international magazines, and advertising ideas generated by lay subjects who were given complete creative freedom (*21*). The ads represented cars, electronic appliances, alcoholic beverages, and food products.

The independent judges rated the award-winning ads highest in creativity and originality, although their ratings were not significantly different from those for the magazine ads and the computer-generated ideas. However, in both cases ads generated by laymen were rated as inferior. This pattern of judgments showed up in all four product categories.

How did template-matched ad ideas compare with ads that were not based on templates? Template-matched ideas generated in a human-ideation process were rated highest, template-matched ideas generated by the computer were rated lower, and nontemplate human ideas were rated lowest. This finding was obtained both for creativity and originality judgments.

The human lay subjects given complete freedom to create failed to reach even the low threshold of creativity determined by the simple computer routine. This underscores the degree of impedance in creativity that human inventors face under conditions of freedom of thought. Indeed, the computer-generated ideas are rated higher than those produced by those human inventors.

A structured process is the key. In creative thinking we seldom utilize even those regularities that we have at hand. In the present century alone, relational structures have been developed in a variety of disciplines—linguistics (Eco, 1986; Chomsky, 1978), anthropology (Levi-Strauss, 1974), random graphics (Palmer, 1985), venture and transitional management (Kauffman, 1995), psychology (Simon, 1966), and artificial intelligence (Minsky, 1988). At least some of these structures, beyond serving as frameworks of historical organization, are potential resources for inventive thinking.

One justification for examining regularities as potential sources for creativity is that structures resembling the replacement template, developed and applied in other fields, have been valued as creative (*22*). Creativity perception may be enhanced because these structures match certain attractors, namely, paths that the self-organized mind tends to follow (*23*). Evidence for the superior creativity of template-matching ideas has been found in new product ideation (*24*), technological innovations (*18*), and in advertising (*25*).

We should encourage creativity in new ways. Randomness is still clearly of value: several of the greatest inventions in history occurred randomly, as nonreplicable creative sparks. Randomness should be reserved, however, for problems in which constraints originating in noncreative requirements limit the solution space to a unique or to a very small number of solutions. Most creativity tasks cannot be accomplished by a random search, and the search might be harmful at worst, or inefficient at best.

Regularities can serve as skeletons or an infrastructure for generating creative ideas. With these regularities defined, outlines of the main parameters can be fed those ideas that conform to these parameters. This framework is likely to produce ideas that are perceived as creative, even though the well-defined rules and the exhaustive search used to obtain them are not what we traditionally viewed as pure creativity. Yet, creativity is assessed by the eyes of the beholder, not by the process by which it comes about. We must reappraise our fundamental approaches to creativity and reevaluate its operational definition.

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