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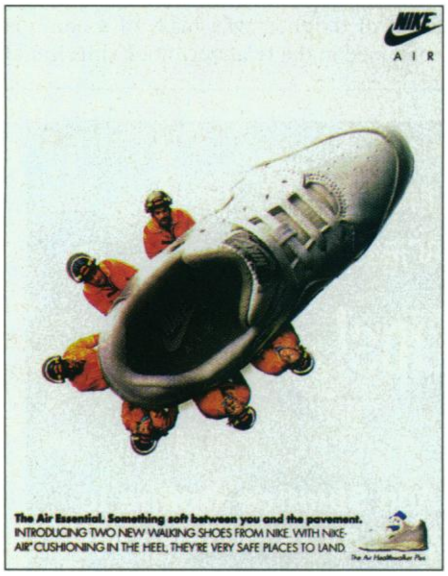
Scrutinizing Creativity

In their Essay on Science and Society contribution, "Creative sparks" (*Science*'s Compass, 3 Sept., p. 1495), Jacob Goldenberg, David Mazursky, and Sorin Solomon advocate a "structured process" and "relational structures" to enhance the creative output of problem-solving. They seem to convey the idea that the process of creativity is the same for groups and individuals. But the processes for the two are qualitatively different and should not be conflated.

Each person referentially interprets problems, as well as any imposed "structures" constraining their solution, according to his or her own history (the sum of developmental and experiential histories unique to each person). Each such personal reference, call it "epsilon," is itself a structure. (Therefore, no experience—including the creative process—is free of constraints or poised to explore "infinite" solution space.) Epsilons of members of creative groups add noise to the solution criteria, which means that a solution set arrived at by creative groups, while of higher "quality" than that arrived at by an individual, is also much less likely to be unique, because of the contributions of multiple epsilons.



A computer-generated ad based on a "creativity template."

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Broadly speaking, groups use an algorithmic type of solution method to produce conventional solutions to well-defined problems, whereas functionally, individuals are better at producing the long-shot solutions to problems that connect disparate elements in unintuitive ways, the type of solutions that occasionally reach a Kuhnian status (*1*). Such new ideas emerge through the structured environment in a manner similar to new species' emergence through natural selection in biological evolution, an analogy described by A. Hudder in her letter (*Science*'s Compass, 1 Oct., p. 49). In more general terms, ideas emerge through a complex series of clustered dynamical systems and environments (*2*). Biological species are solutions to the problem of which organism type suits the existing environment (*3*). The mystery attending all such emergences derives from the abstrusely ephemeral network connections between problem-solving elements and their multidimensional dynamical environments (*3*). Predicting the suitability of a solution (in trivial cases) is directly related to semantic meaning (*2, 3*).

Contrary to Goldenberg *et al.*, neither reappraisal of "our fundamental approaches to creativity" nor reevaluation of "its operational definition" seems necessary, because any proposed methodology will only be useful in defined settings. Depending on the problem and the desired type of solution, a group or an individual will be a more appropriate choice to address the problem. Groups (and computers) derive the algorithmic kinds of solutions to those problems having well-defined solution spaces. Individuals, on the other hand, are better at those larger-than-life kinds of problems having no apparent solution method (the problem itself is often only dimly recognized).

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Response

We found that "creativity templates" (implicit regularities in the creative process) are effective in extracting creative ideas from a potentially infinite-dimensional space of solutions. The fundamental problems solved by scientists in the framework of the Kuhnian paradigm (*1*) do not fall within this class. Such problems have unique, singular solutions because of the overwhelming constraints imposed (independently, in addition to, and above the creativity requirement) by the scientific data. For example, Albert Einstein's theory of relativity has been adopted because it is the best hypothesis to fit the data, not because it is creative. As for the class of solutions drawn from an infinite-dimensional space, without Pablo Picasso, *Les Demoiselles d'Avignon* would have remained forever immersed in the infinite sea of creative potentiality (*2*).

To understand the difference between these two dynamical regimes, imagine the space of ideas as a "conceptual space" in which each location represents a particular idea. Similar ideas are represented at neighboring locations. The solutions to a given problem might be concentrated in a few spatial regions ("conceptual basins") separated by thick "walls" of inconsistent (nonsolution) ideas. A usual idea search that requires logical consistency at each step will therefore rarely be able to escape the conceptual basin in which the search has started: It will keep bumping on the "inconsistency walls" that delimit the basin.

The templates are (as Hollenberg alluded to in his letter) similar to cluster algorithms (*3, 4*) that facilitate global, directed (rather than local, random) jumps between different conceptual basins. This is achieved by forcing the concept dynamics to pass at intermediate stages through the "walls" of inconsistent logic. These methods are not suited for problems in which there are no such basins and walls and where the solution is just a unique, singular point (*5*).

We maintain that our findings require a reappraisal of the human relation to creativity: According to the Webster dictionary (*6*), the words "creative" and "mechanical" are antonyms ("creative evolution is evolution that is a creative rather than a mechanical, explicable process"). Yet our human judges systematically gave high creativity grades to the output of a mechanical computer procedure, showing that there is a clash between what humans declaratively define (*6*) as creative and the operative definitions that humans actually apply in practice.

Contrary to the central issue raised by Hollenberg, the similarity we drew between the creativity of structured groups and that of individuals merely exemplified the deficiency of unstructured methods in enhancing creativity. However, this issue was only remotely related to our main focus on human incapability to outperform a template-based, idea-generating computerized routine.

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A Comb-Wide Web

Honeybees as master engineers—the proof is in the honeycomb. A mathematical proof by Thomas Hales, reported in Dana Mackenzie's News of the Week article "Proving the perfection of the honeycomb" (27 Aug., p. 1338), shows that honeybees make optimal use of wax and space in the construction of their combs. Such calculations are based on the geometry of the comb cells and hence take into account only the wax in the thin walls of the cells. However, about 30% (in some cases up to 50%) of the total wax mass of a comb is contained in the relatively thick rims found