

Design Science Research  
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## Are Computers Creative?

A Review of the Article "Computer Models of Creativity" by Margaret A. Boden.

One characteristic that distinguishes humans from machines is that we are creative. This has been a long-time goal for AI community, to build intelligent machines that are also creative. However, the community has fallen short. Many otherwise hardheaded scientists, doubt—or even deny outright—the possibility of a computer's ever being creative.

Can computer really be creative? To answer these questions, first, we need to figure out what is creativity and what are the types of creativity.

Creativity can be defined as the ability to generate novel, and valuable, ideas: first, valuable can mean interesting, useful, beautiful, simple, richly complex, and so on; then, ideas cover not only ideas as such (concepts, theories, interpretations, stories), but also artifacts such as graphic images, sculptures, houses, and jet engines; the third, novel can be divided to psychological and historical new ideas. Based on novels, there are two type of Creativity P-Creativity and H-Creativity. P-creative idea, a psychological novelty, is one that's new *to the person who generated it*. Some other people have had that idea before where someone borrows and idea from one industry or sector and apply it to another. H-creative idea, a historical novelty, is one that has never occurred in history before and this would be someone who came up with a thought or concept that no one in the history of mankind has ever thought of.

Also, there are three type of Creativity based on models: Combinational Creativity, Exploratory Creativity, and Transformational Creativity.

- Combinational Creativity, it involves new unfamiliar ideas from combinations of familiar ideas.

- Exploratory Creativity, it involves the generation of new ideas by the exploration of structured concepts.
- Transformational Creativity, it involves the transformation of some dimension of the structures, so that new structures can be generated.

Are computers really creative?

Creativity is a feature of human intelligence that grounded in everyday capacities that associated with ideas, perceptions, analogical think, exploring a structured problem-space, and reflective self-criticism, etc. Based on the article Computer Models of Creativity, Margaret Boden, the author stated that the AI scientist need to know how the creativity worked and could apply it to computer model. She also stated that novel ideas in creativity can be produced through three models: computer combinations, computer exploration, and stylistic transformations. Are computers creative? It depends on different models and its conditions.

First, computer combination creativity model, that making association links between ideas to produce new or familiar ideas from old or exist ideas, works as the analogy that exploited shared conceptual structure in poetic imagery, collage in visual art, etc. By connecting familiar ideas together producing some of new ideas, yes, I am agreed with that it is kind of creativity, for instance, poetic imagery, a computer combinational model did can create new images that no one ever seen before. Yet, it is only based on the stored database from old exist images. This type of creativity, the achievement is limited, in which it is lack of access to a rich store of knowledge, and lack of an associative memory and search process. Most important, it is lack of evaluation criteria that it is easy to generate random combination but many of them maybe not valuable. Thus, computer combinational creativity is kind of creative activity with limited achievements and need under certain circumstance such as large amount memory stores, but it is not real creativity as human beings.

Second, computer exploration model, the rules of the relevant thinking style be put into the computer program in a specified clearly way, in which the programmer explicitly tell the computer what to do. Exploratory creativity involves the generation of new ideas by the exploration of structured concepts, in which computer can move through a conceptual space to explore it to find out what's there. In our real life, lots of artists spend their lifetimes exploring and mastering these conceptual spaces and produce marvelous creative products. In the most interesting cases, people discover both the potential and the limits of the space in questions. Modeling exploratory creativity requires not only advanced AI skills but also expertise in, domain concerned, and deep insights, too. Let's go back to computer creativity, yes, there has been greater success here in computer exploration: in many exploratory models, the computer comes up with better products that sometimes even superlative than those highly competent human professionals, such as BACON family of programs that discovered many famous laws. If we only focus on the products the computer made, yes, the computer is creative. However, the only problem here is those exploratory rules, that need to be input the computer program specific and clearly, totally rely on the programmers. In this perspective, I think it's not really creative, but programmer is.

Third, transformational creativity, which involves the transformation of some dimension of the structures, so that new structures can be generated. In transformation creativity, the space or style itself is transformed by altering one or more of its defined dimensions, as a result idea can be generated. The more fundamental the dimension concerned, the more powerful the transformation, and more surprising the new idea will be. In computer transformation, the computer can come up with a new style that the rules and instructions specified in the program determine its possible performance, here we include its responses to input from the outside world, the program includes rules for changing itself. For example, in genetic algorithms, Gas can make random changes in the program's own task-oriented rules- selection, crossover, and mutation. Karl Sims' genetic images that programs from the parents are concatenated, nested, and mutations are applied to produce a new generation of images. From this perspective, yes, computer is creative. However, it also under certain conditions and context. One critical problem of this model is sometimes the resulting structures may not have any interests or value, and it lack mechanism sufficiently powerful

to realize the poor quality of the new constructions and drop or amend the transformations accordingly.

Thus, computer models to mimic creativity can be designed. Computer models sometimes can be designed to aim for or even achieve to H-creativity. Often, however, computer models aim merely for P-creativity. For creativity models, depends on the programmers, it can be designed to three type of creativity models, either Combinational Creativity model, or Exploratory Creativity model, or Transformational Creativity model.

In conclusion, from my own perspective, computer may be creative under certain conditions and context, yet, it's not really creative, at least not now. Truly creative thinking will always remain beyond the power of any machine