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How can computers be partners in the creative process: Classification and commentary on the Special Issue

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Abstract

The different ways that computers can be involved in creative work are examined. A classification based on four categories of human–computer interaction to promote creativity is proposed: computers may facilitate (a) the management of creative work, (b) communication between individuals collaborating on creative projects, (c) the use of creativity enhancement techniques, (d) the creative act through integrated human–computer cooperation during idea production. The papers in the Special Issue are discussed according to this classification. Issues to be considered in future work on human–computer interactions for promoting creativity are discussed.

Keywords: Creativity; Human–computer interaction

1. How can computers be partners in the creative process?

The papers in this Special Issue focus on ways that computers can contribute to people's creativity. Some of the contributions draw insights from informal experiences of computer use and its impact on idea generation and realization.

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Others employ field observations of creators at work or experimental designs under controlled laboratory conditions to shed light on the best ways to integrate computers in original thinking.

Apart from Sternberg's overview (in this issue) of questions that may be raised about the nature of creativity, it is possible to organize the suggestions offered in the eight papers on human–computer interaction for enhancing creativity along four lines of thought about the role of computers: computer as nanny, computer as pen-pal, computer as coach and computer as colleague. In the next section, I will describe these four possible futures for computers in the field of creativity. Then, issues concerning the creative process will be discussed.

2. Computer as nanny

Being creative is not simply a matter of generating wild ideas in a quick brainstorming session. In fact, creative projects involve often-prolonged periods of work, in which doubt, ambiguity and a lack of perseverance can lead to people to abandon the creative process. In fact, a survey of successful inventors showed that perseverance was the most frequently cited attribute needed for creativity. It is possible that computers can encourage creativity by monitoring the working process and supporting the potentially creative person as he or she proceeds. For example, Burleson proposes in his article that computers can help people to handle time pressure by "setting" deadlines to keep a project on schedule and reminding the user of this contract, or by monitoring the user's work and pointing out problems of procrastination, or problems of too many interruptions. A lack of breaks can itself lead to fatigue and sub-optimal performance, so computers could improve users' quality of life and perhaps foster creative incubation by proposing breaks to their users (see Selker, this issue) Computers could even help people set their agendas in line with their priorities, planning out user's activities to keep blocks of time for creative projects.

Selker notes that speed and facility of computer use are important to allow users to express their creativity without being slowed down by technology. Yamamoto and Nakakoji's proposal, which was illustrated by a text-editing system that represents a user's document, the idea structure of the document and the contents of each textual element, can be placed in this category as well. Edmonds, Candy, Fell, Knott, Pauletto and Weakley in their paper expose how visual programming languages can be useful in artistic creativity. These authors argue that a computer system will guide a user implicitly to represent and manipulate ideas with more or less facility. Hewett (this issue) notes as well the importance of systems allowing for multiple representation formats and providing the creator with a kind of virtual notepad to jot down easily ideas that come to mind and to store ideas that have already been processed. In a similar manner, computers could free up users' minds by taking care of routine tasks such as periodically saving files. Thus, the computer system can be designed in terms of its affordances (in the Gibsonian sense) as a support for creative thought.

3. Computer as pen-pal

Part of being creative involves communicating ones ideas. This is the case for individual creators who interact with the audience that evaluates, interprets and eventually integrates new productions into domain-relevant knowledge bases. However, the importance of communication is even more central to collaborative creative acts, involving two or more individuals. Fischer, Giaccardi, Eden, Sugimoto and Ye, in their contribution, suggest that collective creative acts are increasingly common practice. Such creative communities can facilitate their interactions through computer technology. In one example, individuals with personal digital assistants developed their own ideas and fed them into a global representation that itself could be modified online. Some computer-based representations integrate real objects which can be moved in physical space as people discuss. Such evolving computer representations have been found to facilitate the exchange of ideas between diverse actors in complex problems such as urban planning. Electronic mail and electronic conferencing software allow collaborations between individuals across time and space. Thus, the potential for more diversified, collaborative projects involving heterogeneous teams is possible and can enhance creativity (see Edmonds et al., this issue). In this vein, the development of electronic brainstorming software that allows individuals to exchange ideas electronically, yielding a common pool of ideas that itself is submitted to group discussion, illustrates well the computer as a networker or facilitator.

4. Computer as coach

Given that a large number of cognitive processes are probably involved in creative thinking, it is almost certain that an individual does not master all of them and may not even be aware that certain kinds of thinking may be useful in a task. Thus, the computer as an expert system, knowledgeable in creativity-relevant techniques, can help the user to go as far as possible. The computer can provide information in different ways that people can come up with creative ideas, which can serve as analogs to jump-start the creative process (see Hewett's article). Also, information about the existing techniques to stimulate creativity can be proposed. If a user is interested in trying to use a certain cognitive process such as divergent thinking, metaphorical thinking, or free association, the computer can provide tutorials and exercises to use (see Hewett's proposed computer "workbench" for creativity, this issue). The concept of a computer coach fits well with Bonnardel and Marmèche's proposed system (this issue) for supporting creative design. The system that they recommend for facilitating design tasks couples a database of potential sources of inspiration for object design (based on expert's spontaneous sources) and information on points of view to be considered, with a diagnosis-assistance module to guide designers to new ideas.

5. Computer as colleague

The most ambitious vision of human–computer interaction for creativity involves a real partnership, in which humans and computers work hand in hand (see Burleson's article in this issue which evokes synergistic hybrid human–computer systems). The idea here draws on work in artificial intelligence in which computers can themselves be creative, or contribute new ideas in a dialogue with humans. Boden (1992) reviewed a number of programs that seek to be creative in science, art, music and other fields. For example, Johnson-Laird (1988) developed a jazz improvisation program that produces variations of initial musical sequences according to a set of rules implicitly employed by many jazz musicians. Langley et al. (1987) developed a series of programs that seek to discover scientific laws in submitted data sets using heuristic search techniques. We can imagine a creative team composed of a human–computer duo in which the user proposes an initial idea, that the computer modifies in a random or heuristic way, which in turn the human modifies in a cycle that continues until the user or outside judges decides that the production is satisfactory. One tactic in creative thinking is to rely on random or semi-random search mechanisms to generate novel, unconventional ideas. This is especially useful, according to many authors, when one is stuck and keeps re-visiting to a non-optimal idea. Computers can probably better implement random searches than humans but humans are needed to select the best ideas and perhaps to fine hone these ideas, turning them into viable creative productions.

In fact, one criticism of artificial intelligence programs that claim to be creative is exactly that a human plays a role at some point, which reduces the autonomy of the machine. From the HCI perspective that is developed in this Special Issue, these "failed" AI creativity programs are examples of successful human–computer interactions to facilitate creativity. Thus, it is possible to conceive of computers as real partners in the creative process intervening at different points in order to generate, evaluate, or refine ideas and bring them to full-fledged products. Furthermore, as Edmonds and Candy illustrate through case studies of artistic creativity, computer technology can be incorporated in the creative act as a support for the creator's visual or musical expression. In this way, the computer is also fully integrated with human creative activity.

6. Discussion

All four possible modes of human–computer interaction can be pursued simultaneously. Given the diversity of problem types, from those that require building on existing paradigms to those that require paradigm shifts, from those that involve redefining the problem to others that call on synthesis to put together existing ideas in a new solution, it is likely that "the" creative process does not exist. Rather there are a set of creative processes that vary with the problem type (see Sternberg, this issue; Lubart, 2000–2001). Thus, no single HCI solution can be expected to be optimal in all circumstances.

In a similar way, people (users) differ greatly on their profile of abilities, preferred working styles and personality traits. According to the multivariate perspective on creativity, intellectual abilities (such as analogical thinking, divergent thinking, selective combination skills) and domain-relevant knowledge, thinking styles (such as being more or less detail oriented), personality traits (such as risk taking, tolerance of ambiguity, openness, perseverance) as well as other factors interact to yield creative potential (Sternberg and Lubart, 1995; Lubart, 1999; Lubart et al., 2003). Clearly, the needs of one user may differ from those of another. As Bonnardel and Marmèche reported in their article, novices and expert designers differ in their creative process and the kind of help that a computer system could best provide depends on the user's level of expertise.

In terms of the different categories of human–computer interaction proposed above, some people would like to have their computer play the role of a nanny whereas others will find it annoying. Certain users will find that electronic communication enhances their exchanges, in contrast to other users who find it an impoverished mode of interaction compared to traditional face-to-face conversation. Some users will benefit from help menus that offer creativity techniques whereas others will find it distracting. Some people will be more willing to engage in creative thinking with their computer partner than others. These differences may seem minor when placed in contrast to the goal of a system that meets the average users' needs most of the time. The problem, according to a multivariate perspective on human creative ability, is that there is no "average" person, but rather a large number of possible profiles that ultimately yield average levels of creative performance because people lack a certain number of abilities or traits within the large complete set.

This Special Issue provides new advances on computer-facilitated creativity. The key to designing truly useful systems may be to clarify the nature of the computer's contribution for each proposed system, how it fits with the nature of the creative thinking task and to what extent the system provides what the user lacks in order to be creative rather than being redundant or contradictory with the users own ways of functioning.

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