

## Chapter 16

# Computers and Creativity: The Road Ahead

Jon McCormack and Mark d'Inverno

**Abstract** This final chapter proposes a number of questions that we think are important for future research in relation to computers and creativity. Many of these questions have emerged in one form or another in the preceding chapters and are divided into four categories as follows: how computers can enhance human creativity; whether computer art can ever be properly valued; what computing can tell us about creativity; and how creativity and computing can be brought together in learning.

### Where to From Here?

At the end of the book it seems important to consider the most critical questions that have arisen whilst editing the preceding chapters. Throughout the book, a broad range of views on computers and creativity have been expressed. Some authors argue that computers are potentially capable of exhibiting creative behaviours, or of producing artefacts which can be evaluated in a similar context as human artworks. Others believe that computers will never exhibit autonomous creativity and that we should think of computers and creativity only in the sense of how computers can stimulate creativity in humans. A number of authors even downplay the concept of creativity itself, seeing other approaches such as training and practice, or social mechanisms, as more central in understanding the creation of novel artefacts.

Whilst there is some disagreement about the relationship between computers and creativity, there is a general consensus that computers can transform and inspire

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Jon McCormack  
Centre for Electronic Media Art, Monash University, Caulfield East, Victoria 3145, Australia, e-mail: [Jon.McCormack@monash.edu](mailto:Jon.McCormack@monash.edu)

Mark d'Inverno  
Department of Computing, Goldsmiths, University of London, UK, e-mail: [dinverno@gold.ac.uk](mailto:dinverno@gold.ac.uk)

human creativity in significantly different ways than any other artificial or human made device. The range of possibilities is evident in this volume, which contains many exciting efforts describing the computer's use in developing art practices, music composition and performance.

Nevertheless, on the broad issue of how computers relate to creativity, we are still left with many more questions than we have answers. This final chapter contains a selective cross-section of what we think are the twenty-one most important questions, many of which are raised in one form or another in the preceding chapters. Whilst all these questions are clearly interrelated and overlapping, we have categorised them into four topics: (i) how computers can enhance human creativity, (ii) whether computer art can ever be properly valued, (iii) what computing and computer science can tell us about creativity, and finally – while not covered specifically in this book but an important motivation for future research – (iv) how creativity and computing can be brought together in learning.

### **I How Can Computers Enhance Human Creativity?**

- i No one likes software that makes simplistic assumptions about what we mean or are trying to do (think of the failed Microsoft Word paperclip or automated typing correction). This raises the question: what are the kinds of responses and interactions we desire of computational systems so as to inspire, provoke, and challenge us to develop meaningful creative dialogues with machines, and to have both the confidence in the system and in ourselves?
- ii Relatedly, how can we remain mindful about the ways in which new technology can limit or defer creativity? We are increasingly seeing software developed which is intended to make creative decisions on our behalf. For example, modern digital cameras now take responsibility for many aspects of the creative photographic process, automatically adjusting numerous dependent properties in order to give the “best” picture. Should we be concerned when creative decision making is implicitly transferred to software at the expense of human creative exploration?
- iii Can we re-conceptualise the methods of interaction between computers and people so as to better encourage creative flow and feedback? We have had many years of the mouse, keyboard and screen as the primary interface, but we have now entered the era of networked mobility and surface touch interfaces, where simple hand or body gestures form the locus of interaction. What new ways of enhancing creative exchange are possible if we move beyond the standard mass-market paradigms and consumer technologies?
- iv How can our developing relationship with computers be better understood in order to encourage new opportunities for experiencing both human- and computer-generated creative artefacts?
- v Is there a point at which individual human creativity can no longer be enhanced by technology or society, no matter how sophisticated? A number of recent computational systems have demonstrated a “counterintuitive” design logic that exceeds human designs significantly. These designs were

possible for a computer to find, but seemingly impossible for human designers to discover. Will the goal of augmenting or enhancing human creativity always be limited by our cognitive capacity and inherent genetically and socially conferred biases? Do computers face different limitations, or can they exceed areas of human creativity independently as they have begun to do in limited areas of human endeavour?

## II Could Computer Art Ever Be Properly Valued?

- i When is the computer considered to have had “too much” involvement in the process of making art? To what extent is the produced artefact then devalued as a potential work of art because of the amount of automation? Is it right to challenge this perception, and, if so, how can it be challenged?
- ii What are the implications of being clearer and bolder about just how much computing is impacting on any creative output?
- iii In relation to the previous question, are there ways of revealing the process of computation that would provide an alternative or additional aesthetic to the completed artefact or of the developing partnership between computers and artists in producing their art?
- iv Does it even make sense to ask if the same value system that humans use to experience art can be applied to art made by a computer? If not, then is there another value system that we can use to interact more richly and less dismissively with computer generated artefacts?
- v What creative authorship can we attribute to a work that is assembled from existing code that has been written by others (who may be anonymous)? There is clearly creativity in a remix or mash up (where different musical fragments are brought together for a specific project), even though we know the person doing the remix was not the original composer of each musical phrase or fragment. With software things are different because the code is generally hidden and is not so distinctively familiar as it is with music, for example. This creates a new and challenging perspective about the ambiguity of authorship in art that is partially or completely produced by software.

## III What Can Computing Tell Us About Creativity?

- i Is autonomous creative thinking beyond the capacity of any machine that we can make now or in the future?
- ii Does creativity necessarily involve the creation of useful or appropriate novelty? Relatedly, how relevant is “value” to the definition of creativity? And what kind of value matters most?
- iii Broadly, the humanist view values what humans produce above what all other things produce. Does the ability of software to produce unusual and potentially non-human work mean that it can ever be given equal or even greater value? Could we potentially benefit in some way by challenging our value system and rethinking how things have value (and not just to us)?
- iv What is the most practical approach to building creative systems? Should we aim to mimic our own creative behaviour, the behaviours we find in na-

ture, or design completely new mechanisms? How can concepts of “emergence” be usefully exploited in designing creative machines? Is it enough for a machine to produce new combinations of existing primitives or does it have to create completely new primitives to be a truly creative system?

- v If we could ever define an algorithm that described in detail everything we do as artists, then do we necessarily become limited as artists within that description?
- vi The concept of creativity itself has changed significantly over the years. How will the increasing adoption of computers for creative use change the concept of creativity further?

#### IV How Does Creativity and Computing Matter to Education?

- i Computing is not seen as a creative subject by the general public or even at schools and universities in many countries around the world. How then can we change the perception of computing, especially in early learning, so that programming is seen as an engaging creative subject in the same way as science, music and the arts? How can we then inspire students to develop their creativity through computing?
- ii In asking numerous friends, students and colleagues who are artists and musicians, and who have mastered both their artistic and programming practice, whether artistic creation is more or less creative than programming, nearly all say they are equally creative. Certainly we have never heard anyone say that playing music is creative but programming music software is not, for example. How can we use this kind of personal evidence to persuade people in education and the arts that programming is also a creative act?
- iii What kinds of environments provide the right level of feedback, intuition and control to inspire the idea of programming as a creative act in early learning?
- iv Can we find new ways of revealing and explaining computational processes where the flow of computation is more readily accessible to an audience? Could that help us in our desire to attract a greater diversity of students into computing?
- v Many companies are now beginning to recognise that they want technologists who can think like artists. However, traditional methods of education in mainstream computing that focus exclusively on engineering-based problem solving will not be sufficient for the new challenges of software development. How can we design university computing programs that provide graduates with the necessary knowledge and skills to best achieve their creative potential?

Undoubtedly there are many more questions that could easily be posed here, but it’s clear to us that a better understanding of how computing impacts upon creativity in all its guises will become increasingly paramount in coming years. Looking back at the last decade, there is little doubt that the most influential new development with

computers in this period has been their role in enhancing our social and cognitive space, and it is now social concerns that drive the design of many major computing initiatives. Looking to the future, whilst it is clear that social concerns will remain a driving force in the design of software, it also seems clear that many of the next major innovations in the design of hardware and software will come from attempts to extend our individual and collective creativity. As we set about building these future computing systems, we hope that this book has served to inspire new ideas on the origins, possibilities, and implications of the creative use of computers.

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