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Author

Dartnall, Terence

Published

2005

Journal Title

Metascience

Version

Accepted Manuscript (AM)

DOI

[10.1007/s11016-004-8089-z](https://doi.org/10.1007/s11016-004-8089-z)

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Conceptual Spaces and Creative Minds

Margaret A. Boden, *The Creative Mind: Myths and Mechanisms*. London and New York: Routledge, 2004. Pp. xiii + 344.

£13.99 PB, £45.00 HB.

By Terry Dartnall

This is the second edition of *The Creative Mind* (hereafter TCM), which was originally published by Weidenfeld and Nicolson in 1990. This edition has a new 10-page introduction that outlines Boden's theory of creativity and a 17-page epilogue that describes some recent computational models of creativity. The main text remains the same except for some minor clarificatory changes and the inclusion, in Chapter 7, of some material on Douglas Hofstadter's COPYCAT program.

The programs described in the epilogue include JAPE, which generates low-key puns such as "What do you call a depressed train? A low-comotive", and "What do you call a strange market? A bizarre bazaar" (p. 305). Boden tells us about 'Letter Spirit', which is the latest and most ambitious project to come out of the Hofstadter/FARG stable at Indiana University, Bloomington. 'Letter Spirit' designs new fonts in the lower-case Roman alphabet. Boden says that it is a connectionist system.

Hofstadter stresses that it is not a connectionist system. His complaint about connectionist systems is that once you have trained them up the processing whooshes through all in one go, without any of the compromise and give-and-take that characterises human creativity. It is true that 'Letter Spirit' has a low-level, stochastic architecture, like a connectionist system, but unlike a connectionist system it is highly modular. The decision-making is kicked around between its modules and the creative product emerges out of this. (Ideally, it emerges out of a resolution of tension between conflicting modules.)

Boden also tells us about David Cope's program 'Emmy', which generates music by (so to speak) decomposing, labelling and reassembling musical compositions. 'Emmy' can do this with composers as diverse as Bach, Mahler, Prokofiev, and Joplin, and she can combine styles as diverse as Baroque and Balinese. I did hear that she was at work on a Mahler opera (Mahler didn't write an opera, of course). Boden says that the music on Cope's CDs is played by human musicians. In fact the music on one of them (*Bach by Design*) is played by a computer, and it is predictably lifeless and dull. Boden also tells us about IMPROVISOR, which is a jazz program that can improvise in real time, the story-writing programs MINSTREL and BRUTUS, and genetic-algorithm programs that can generate infinitely many coloured images.

Routledge, the publishers of this edition, asked me to report on the viability of a second edition of TCM. I said that a new edition should include a chapter in which Boden responded to her critics. She has not done this, and I think it is a lost opportunity. She did the spadework in replying to a Peer Review of TCM in *Behavioral and Brain Sciences* (17:3, 1994) and in her Reply to Reviewers in *Artificial Intelligence* (79, 1995). In the preface to the new edition she says, "Because *The Creative Mind* was written for a general audience, I haven't detailed the many comments I've received since it first appeared" (p. ix). Well, that is a pity. The book would have been a lot more interesting if it had included such material, and by replying to her critics she might have shed light on some of the murkier aspects of her theory – especially what she means by a 'conceptual space'.

In what follows I shall outline Boden's theory of creativity as it appears in the new introduction. I shall then look for a more detailed account in the body of the book. Then I shall revisit my criticism of it in *Behavioral and Brain Sciences*, 17:3 and I shall supplement this criticism with material from Dartnall, ed., *Creativity, Cognition and Knowledge: An Interaction* (Praeger, Westport, 2002).

In the new introduction, Boden says that she distinguishes between combinatorial, exploratory and transformational creativity. Combinatorial creativity involves making “unfamiliar combinations of familiar ideas” (p. 3). Examples include “poetic imagery, collage in painting or textile art, and analogies.” (ibid.) Exploratory creativity is where we explore a conceptual space, and transformational creativity occurs when we transform a conceptual space. She believes that computational concepts can help us to understand all three types of creativity.

The question is: what does Boden mean by a ‘conceptual space’? In the new introduction she says it is a “structured style of thought” (p. 4), so that “someone who comes up with a new idea within that thinking style is being creative in the second, exploratory, sense” (ibid.). Transformational creativity involves someone thinking something which, “with respect to the conceptual spaces in their minds, they couldn’t have thought before” (p. 6). They have to transform the structure of the space by changing the rules that govern it.

That still leaves us pretty much in the dark about what conceptual spaces are, so we have to look in the body of the book for the details. Even then it is quite difficult to pin the notion down. Part of the problem is that, rather than coming out and straightforwardly saying what a conceptual space is, Boden wants the nature of conceptual spaces to be revealed with respect to the puzzle alluded to above: how can we account for the fact that some sorts of creativity are *impossible* with respect to a particular framework of thought? Her answer is that a conceptual space is a space of structures generated by the rules of a generative system, so that some structures cannot be generated within the confines of a particular system. They “cannot be thought” within that system. In order for us to come to terms with them we have to transform the system so that it can generate the structures (or use another generative system, of course). Boden’s favourite example is the way in which, by “passing from ‘string’ to ‘ring’, Kekule’ created the possibility of a whole new science: aromatic

chemistry (the study of the benzene derivatives)" (p. 71). She says that the conceptual space of contemporary chemistry deemed ring-structures impossible, so that they could not have been thought within that framework (p. 63). I do not know enough about the history of chemistry to be able to say whether this is a good example. I suppose that another example is that within the confines of Newtonian physics it is unthinkable that light waves should bend: it is *logically* impossible for Newtonian physics to be true and for light waves to bend. Similarly, within the framework of Euclidean geometry it is *logically* impossible for the sum of the angles of a triangle to be other than 180 degrees.

For Boden, then, a conceptual space is defined by a generative system. "To justify calling an idea creative [in the interesting, transformational sense]... one must identify the generative principles with respect to which it is impossible" (p. 51). She goes on to say, "Computational concepts help us to specify generative principles clearly . . . computer modelling helps us to see what a set of generative principles *can* and *cannot* do" (p. 52).

Now to my criticism. A generative system generates a (usually non-finite) body of structures out of a finite set of elements through the application of a finite body of rules. A good example is a generative grammar. A generative grammar starts with a single, atomic symbol and generates strings of atomic symbols by rewriting one symbol at a time through the sequential application of rewrite rules. When the string contains only terminal symbols the symbols are replaced by words from a lexicon, giving us an interpreted string (usually a sentence). Boden uses generative grammars to illustrate what she means by a generative system (p. 49–52) and generative grammars feature throughout the book. She talks about English grammars (p. 48ff, p. 94, pp. 184–186), grammars of musical harmony (p. 101) and "shape grammars" that generate a space of buildings that adhere to a particular style – Palladian or Frank Lloyd Wright's Prairie Houses, for example (p. 309ff).

I want to know how this notion of a generative system can shed light on creative products such as paintings, poems and sculpture. Generative systems are atomistic. They consist of a set of atomic elements. It seems to me that some creative products cannot be usefully described as atomistic, and some are not atomistic at all. Let us take these in turn.

In my *Behavioral and Brain Sciences* Peer Review of TCM I say, "There is no significant sense in which Verdi's *Requiem*, or *Hamlet*, are combinations of previously existing elements or ideas." (p. 537). Although Verdi's *Requiem* consists of notes and *Hamlet* consists of words, so that they are structures in note-space and word-space, respectively, nothing is gained by such a characterisation. It does not tell us why they are creative, why they are original, why they can move us, and why they shed light on the human condition. In her response Boden says: "I do not understand why Dartnall thinks I believe Verdi's *Requiem* and *Hamlet* to be combinations of previously existing elements. They do involve combinatorial thinking, to generate the imagery and the literary or musical allusions. But, as I said repeatedly, music and plots are complex structures requiring exploratory-transformational creativity" (p. 559).

Well, *Hamlet* does belong to the conceptual space defined by English grammar and Verdi's *Requiem* does belong to the conceptual space defined by a permissible combination of musical notes. We agree, however, that this is not a helpful or informative thing to say. But if we are not dealing with these conceptual spaces, what conceptual spaces are we dealing with? What are the atomic elements of the spaces and what are the rules? What atomic elements are music and plots constructed out of and what are the rules of combination?

Now it is possible that Boden does not want an atomistic concept of a generative system (and hence of a conceptual space). In that case she should say so and try to provide a non-atomistic account – although it is not clear to me what this would look like. Chapter 5 is called “Concepts of Computation”, so we would expect to find such an account here, if anywhere. We do not find it. In this chapter Boden talks about knowledge representation formalisms, such as semantic networks, frames, and scripts. Such formalisms are notoriously “scruffy” (technical term!). They are put together in a rough-and-ready way to capture aspects of the way in which we seem to think (how we associate concepts, and the way in which we apparently ‘chunk’ knowledge together). They are not formalised, so they do not generate structures by applying rules to atomic elements. Recently, knowledge representation has moved away from scruffy formalisms to the ‘neat’ (technical term!) formalisms of logic. Logic, of course, is in keeping with the standard concept of a generative system, but now we are back to atomic elements again.

So far I have suggested that it is not helpful or informative to regard music and literature as structures in word-space or note-space. In *Creativity, Cognition and Knowledge*. I argue that some creative products are not atomistic at all. When a sculptor chisels a form out of a block of marble or a potter shapes a pot out of a lump of clay they are not generating a product out of a set of elements. When we draw a face we do not assemble a set of elements, as we might put together a face out of an identikit of eyes, ears and noses. The features of the face emerge as we draw the face. The features are properties of the face that do not exist independently of the face. There is no curve of the cheekbone that exists apart from the cheekbone: the curve is a property of the cheekbone, not a component or entity that we can store in an inner identikit. This is the point of Lewis Carroll’s joke about the grin of the Cheshire Cat, which remains when everything else has faded away. The grin is a property of the cat that does not exist independently of the cat. I argue in the book that we generate the drawing of the face out of our *knowledge about faces*, and I suggest that this ability to

generate products out of knowledge is an important epistemological issue that has been largely ignored. (If you think that we do draw faces by putting together eyes, ears and noses, like an identikit, ask yourself how you draw an eye. You construct it out of lines and curves, which are not stored entities. What would it mean to say that we store “the curve of an eye”?)

So what have we got?

P1. Exploratory and transformational creativity involve the exploration and transformation of conceptual spaces.

P2. Conceptual spaces are generated by generative systems.

P3. Generative systems combine basic elements according to rules.

But P4. At least some creative products do not combine basic elements according to rules.

If P4 is true, either P1, P2 or P3 is false (possibly more than one of them, of course). P2 strikes me as a harmless definition of ‘conceptual space’, so it can probably stay. That puts the pressure on P1 and P3. Boden cannot abandon P1 without abandoning her theory, so she has to modify P3 (rather like a Lakatosian auxiliary hypothesis, which cops the arrow of *modus tollens* in order to protect the core of the theory). I have briefly looked at P3. It is not clear to me what a modified, non-atomistic account of a generative system would look like.

Computing and Information Technology
Griffith University
Nathan, Queensland
Australia