Whence is Creativity?

Bipin Indurkhya (bipin@agh.edu.pl)

Department of Computer Science, AGH University of Science and Technology, Cracow, Poland
Cognitive Science Lab, International Institute of Information Technology, Hyderabad, India

Abstract

We start with a critical examination of the traditional view of creativity in which the creator is the major player. We analyze many different examples to point out that the origin of all different creativity scenarios is rooted in the viewer-artifact interaction. To recognize this explicitly, we propose an alternative formulation of creativity by putting the viewer in the driver's seat. We examine some implications of this formulation, especially for the role of computers in creativity, and argue that it captures the essence of creativity more accurately.

Introduction: Traditional View of Creativity

In a typical creativity scenario, there is a creator, a product and the audience. The creator creates the product, and the audience appreciates it. The creativity is almost always imputed to the creator. One could talk about a creative process, but that is again associated with the creator. The audience plays a role, and has been dubbed *the field* by Csikszentmihalyi (1996), but somewhat indirectly, and even then, one usually makes a distinction between a popular artist and a creative artist, which are not synonymous.

This framework is questioned in this paper by analyzing a number of creativity scenarios and tracing the root factor that allows us to dub them creative. It is not the first time that these issues are being raised, for they are well known in the literature. But it may be the first time we are bringing them all together to suggest that perhaps there is something fundamentally wrong with this view of creativity. We then propose an alternative formalism for creativity by looking at it from the audience's point of view. Though this may seem almost heretical at first sight, we argue that it provides a more accurate framework to address various issues surrounding creativity, including the role of computers therein.

Analysis of Some Creativity Scenarios

We present here several creativity scenarios and analyze them to identify the root cause as to why they are labeled creative.

Case of Creative Individuals

If we try to think of creative people, who comes to mind? Perhaps Einstein, Mozart, Michelangelo or Leonardo da Vinci. In the modern times, we might think of Steve Jobs. But what do we mean when we say that they are creative?

Perhaps music came naturally to Mozart. In a letter to his father on Nov. 8, 1777, he wrote: "I cannot write in verse, for I am no poet. I cannot arrange the parts of speech with such art as to produce effects of light and shade, for I am no painter. Even by signs and gestures I cannot express my thoughts and feelings, for I am no dancer. But I can do so by means of sounds, for I am a musician." However, what makes his work great is because of the way people have responded to his music over more than two centuries. (See also Kozbelt 2005; and Painter 2002.)

Steve Jobs has sprouted and nurtured many creative ideas, but again it is how people responded to the artifacts based on his ideas, like Mac, iPod, and iPhone, that is the key factor in his having become an icon of technological innovation and creativity. And one could easily dispute whether he was creative when it came to his clothes.

Einstein's brain was preserved after his death so that people can study it to get any clues about the biological basis for creativity. But here also it is the impact of his theory of relativity, and its eventual acceptance by the scientific community that was a key factor in him becoming an icon of scientific creativity of the twentieth century. Moreover, Einstein was also dogmatic at times, perhaps the most famous case being his rejection of Alexander Friedmann's expanding universe hypothesis (Singh 2004).

Needless to say, we are not trying to argue that these people were not creative, but merely to point out that they were creative some of the times, and in some areas; and, more importantly for the discussion here, that we determine when they were creative based on how the audience responded to their ideas or artifacts.

Creativity in Mentally Different Individuals

Take the case of Stephen Wiltshire, discussed in Sacks (1995). He has an amazing ability to draw a landscape from memory after seeing it only once. Though he is diagnosed with autism, his work is highly regarded both by critics and general population. He was awarded *Member of the Order of the British Empire* for services to art in 2006. So he is no doubt a very creative person, no matter which criterion one chooses to apply.

But let us think about it a minute. What do we mean by saying that he is creative? His work has a certain style, level of details that most people cannot reach, aesthetic appeal, and all that. As with Mozart, we can go further and say that perhaps this is the way he expresses himself naturally: just like you and I might describe what we did on our last summer vacation, he draws fantastic landscapes. The

landscapes are fantastic to us, his audience, and that is the crucial factor in his being recognized as a creative genius.

We can now throw in here examples of people with schizophrenia or brain damage, savants or manic-depressive people, and so on (Sawyer 2006). When these people produce work that is considered creative, it is exclusively the evaluation of the audience that is the key factor in this judgment. For many of them, this is their mode of being, and it could not have been otherwise. Often the intention is missing as well. (See also Abraham *et al.* 2007; Glicksohn 2011.)

Cultural Creativity

In many cultures, art is practiced as a group activity. For example, Maduro (1976) provides a study of *Mewari* painting community in a village in the Rajasthan province of India. It describes a strictly hierarchical group with each artist belonging to one of the *laborers, master craftsmen* or *creative artists* class. They mostly copy existing forms and patterns, with rarely an innovation, at least in the way it is considered in the Western art.

Sawyer (2006) discusses this and many other examples to argue that for such scenarios, one needs to take into account cultural context to evaluate creativity, and novelty may be neither necessary nor sufficient. However, the audience response is still a key factor. Notice that the culture itself can be an audience.

Computer and Creativity

We now consider the scenario at the other extreme, when technically there is no creator and the intent is missing. Even though the last two or three decades have seen a steady progress in the development of computer systems that produce artifacts in the domain of visual art (Cohen 1981; McCorduck 1991), music (Chordia & Rae 2010; López *et al.* 2010; Monteith *et al.* 2010), literature (Kurzweil 2001, Pérez y Pérez *et al.* 2010); and so on, generally they have received a negative press as regard to their creativity: computers cannot have emotions, programs do not have intents, creativity cannot be algorithmic, etc. etc. (Boden 2009; Sawyer 2006). In fact, such views blatantly expose the implicit assumptions underlying creativity: namely that it crucially needs a creator with emotions, intentions, and such. However, we have just seen a number of scenarios above involving humans where the intentions and emotions are missing and, even when they are there, what determines whether something is creative or not is the audience response. So why should we not apply the same yardstick for computer-generated artifacts?

Creativity in Viewer-Artifact Interaction

In all the scenarios above, we have seen that it is the audience response that determines whether an action (of the creator or the group), a process, or a product is creative. So suppose we drop the pretense, stop being apologetic about it, and embrace this view formally: We define creativity *as the process by which a cognitive agent acquires a novel perspective that is useful (or meaningful) to it in some way by interacting with an object or a situation.*

There are two aspects of this definition that need to be emphasized here. One is that we are taking completely the audience's perspective here, so the creator is not even mentioned. Needless to say, this is not the first time that such a position is articulated. Barthes' (1977) concluded: "We know that to restore to writing its future, we must reverse its myth: the birth of the reader must be ransomed by the death of the Author," and he traced this view to even earlier scholars. Moreover, even when one does not take this extreme position, most accounts of creativity do acknowledge the role of audience (Cropley *et al.* 2011; Csikszentmihalyi 1996; Horn & Salvendy 2006; Maher 2010). Our aim here is to explore the implications of this authorless view of creativity, especially for computational systems.

Secondly, both the novelty and the usefulness are defined from the agent's personal point of view. So in this way, this definition refers to little-c creativity, or P-creativity (Boden 1990; Kaufman & Beghetto 2009). However, as we will see soon, it can be extended to Big-C or H-creativity.

Implications of the Proposed View

We will now discuss how many intuitive notions associated with creativity can be rooted in the formulation proposed above. We start with the four Ps of creativity (Runco & Kim 2011).

Product: Potential of Artifacts for Creativity

If an agent can interact with an object to get a novel and useful perspective, we can impute creative potential to that object. If many people can get a novel and useful perspective, it should be emphasized that the perspective that each agent gets need not be the same, or need not be useful in the same way. So, for instance, different agents may see a work of modern art in various ways, and find it meaningful in different ways, and some may not see anything at all.

Though most accounts of creativity incorporate audience response to some extent, the extreme view we are examining here would allow Oracle readings of tea leaves and such as creative interactions. (See also Indurkhya 2007.) Just to contrast, in the traditional view, such objects lack a creator so, by association, lack creativity as well. This is a common argument to deny creativity to computer systems.

Process: Creativity in Generating Artifacts

Now we can take another step back and consider the process of generating a creative artifact. In other words, we need to consider the process of generating an artifact with which a viewer can interact and get a novel and useful perspective. So the viewer is always hovering in the background, and has a significant impact on whether the process is really generating an ordinary artifact as opposed to a creative artifact.

The main implication for modeling the generative aspect of creativity is that we cannot pursue it without considering

the audience, and making some assumptions about how they are likely to interact with the generated artifacts.

Person: Creativity of an Individual/Group

We can step back some more and consider the creativity of an individual or a group of individuals. Here we are looking at the ability of the individual to generate artifacts with which viewers can interact and get novel and useful perspectives. So the viewer is again in the background and is playing a critical role. Moreover, even though we speak of this person or that person as being creative, we are really focusing on certain artifacts that they have generated in their career, which have given their audience some novel and useful perspective.

The implication of this is that though we can certainly study personality traits of certain individuals who generated some artifacts during their career that were deemed creative by the audience, it does not follow that those personality traits in a different culture, in a different context and with a different audience will necessarily result in the generation of artifacts that would also be considered creative. This point is highlighted in the essay 'Late Bloomers' (Gladwell 2009), where early geniuses are contrasted with late bloomers. The relevant point here is that whether a work is accepted by the audience or not does not depend much on whether it was produced early or late in the career, but on the kind of work and the context and the culture in which it was produced.

Press: Context, Culture and H-Creativity

Press refers to the environmental factors that have an influence on the generation of the artifact; but that is taking the traditional perspective, where the focus is on the creator. If we are putting the viewer in the drivers' seat, then an analogous set of environmental factors can be identified that determine how a work is received by the viewer, and whether it is successful or not.

Let us first consider the artifact interaction with an individual viewer. Clearly, the context in which a viewer interacts with the artifact can have a major influence in what perspective is gleaned from it, and whether it is novel or meaningful. The most classic example of this might be Marcel Duchamp's *Fountain,* which was a urinal turned around. (See also 'When is Art?' in Goodman 1978.) There is also the effect of the viewer's background knowledge: when one views the *Parthenon* in Athens, one's knowledge of the history and culture of ancient Greek certainly effects one's perceptions and aesthetic experience.

Moving to larger groups and societies, there are many instances when a novel and potentially useful idea was not successful when introduced in one context, but the same idea was a big hit in another context. We mentioned above the example of Alexander Friedmann's expanding universe hypothesis, which was rejected when introduced because of Einstein's influence but was widely heralded later. Wegener's (1966) theory of continental drift suffered a similar fate when it was first introduced in 1915, even though that was no fault of Einstein.

There are also cases where the theory, although novel and carefully worked out, never received acceptance: for instance, Velikovsky's theory, which hypothesized Earth's encounters with a large comet expelled from Jupiter and provided explanations for many biblical events (Casti 1989, pp. 7–10).

History of marketing and product development also provides many such examples that are studied in business schools all over. Gladwell (2009), for instance, recounts Jim Wigon's not-so-successful odyssey to develop creative ketchup flavors, and contrasts this with mustard and spaghetti sauce, for which similar efforts were more readily accepted by the consumers.

The implication of all this simply is that one needs to study all these contextual factors that make an idea or an artifact novel and meaningful, and thereby eligible for the 'creativity' label. But this is essentially what is called H-creativity: novelty and usefulness for a culture or society. We should emphasize here that this novelty and usefulness with respect to a culture is not the same as popularity. Certain ideas or artifact can be popular in a society without being considered novel (by the members of the society themselves), and vice versa.

Who is Creative?

This is one question that is often asked with regard to artificial creativity systems. For example, who is being creative when the computer program Aaron generates a painting in which many people see some aesthetic value? Is it the program? Is it the programmer? In many complex computational systems, the programmer cannot see all the consequences of what their system can generate, and can be quite surprised by the artifacts it produces.

We would like to argue that this question is meaningless in the framework of creativity we are proposing here. Just to get away from the computational system scenario, consider a painting by a schizophrenic person that many people find interesting and insightful. Now obviously, the schizophrenic person is the creator of the painting. But is she or he creative? How can we determine this? Perhaps it is a natural way for them to express themselves; they may not see what all the fuss is about the artifact they created. In other words, if we zoom out and look at the larger picture, they are creating artifacts that many people find insightful, and so in that sense we can ascribe them creativity as explained above. But if we zoom in on the processes by which they generate these artifacts, where is the creativity? They may not be trying to generate some aesthetically pleasing object, and may not even be aware of any audience. The point is that there is nothing distinctive about the generation process itself that we can label it as creative.

Creativity and Computational Systems

Once we acknowledge that it is meaningless to ask who is being creative, the stigma surrounding the potential creativity of computational systems recedes away. The goal becomes simply to create artifacts that give them some novel and meaningful perspectives.

This seemingly small shift of focus has far reaching consequences, and our society is already moving towards it. To start with, modeling the audience, their cultural tastes and preferences, their cognitive processes that influence their response to novel stimuli, and so on, becomes very crucial. In the last 10-15 years, research in neuroscience has revealed that at least some of our aesthetic values are hardwired in the structure of the brain (Ramachandran & Hirstein 1999; Zeki 2000). Then to add to that, machine learning techniques can *learn* about the cultural preferences of an audience based on the past data. For instance, Ni *et al.* (2011) trained their program with the official UK top-40 singles chart over the past 50 years to learn as to what makes a song popular. A program like this might successfully predict, for instance, the winner of the future Eurovision competitions.

To reiterate a subtle point, creativity is not the same as popularity. So to be able to predict whether a song, or a book, or a video will become popular (Szabo & Huberman 2010) is not the same thing as evaluating their creativity. Nonetheless, we expect that similar techniques, perhaps with some adaptations, are more likely to yield the key to creativity.

Going one step further, once audience-based models of creativity are articulated, we can design, implement and experiment with computational systems that generate artifacts that are more likely to appeal to the audience, both with respect to their novelty and meaningfulness. One could even argue that computational systems are more ideally suited than humans to explore this space of creative possibilities (Harry 1992; Indurkhya, to appear).

Designing Creativity-Support Systems

A related issue is how to stimulate and enhance creativity in people, if it is possible at all. Indeed, a number of approaches have been proposed and tried out over the years (de Bono 1975; Gordon 1961; Holstein 1970; Rodari 1996; Shapira & Liberman 2009). One key observation that recurs in many of these studies is that trying to associate unrelated objects or situations stimulates creativity (Indurkhya 2010). In our past research, we have explored some approaches to design creativity-support systems based on this observation (Indurkhya 1997; Indurkhya *et al.* 2008; Ishii *et al.* 1998), but much more remains to be done.

Conclusions

Though most of the research on computational creativity has implicitly assumed that the creative value is in the artifact, they have been sort of apologetic about it. For example, Colton (2008) argues that it is not enough to generate an interesting or creative artifact, but one must also take into account the process by which the artifact was generated. Krzeczkowska *et al.* (2010) took pains to project some notion of purpose in their painting tool so that it might be perceived as creative.

In this paper we have sought to not only drop this veil of apology, but move to the other extreme by proposing a formulation of creativity that puts the onus on the viewer by characterizing it as the process of getting a new and meaningful insight about an object or situation.

We have argued that this formulation reflects more accurately what actually goes on in the whole creativity cycle. Moreover, other situations, like when we deem an artifact or an individual as being creative, we are really implicitly relying on the viewer-artifact interaction to make this judgment. Therefore, creativity of an agent and that of an artifact are best seen as derived concepts based on our proposed formulation of creativity.

We hope that this will stimulate further discussion about the nature of creativity and, more importantly, will generate new approaches to the design and development of computational creativity systems.

References

Abraham, A., Windmann S., McKenna P., & Güntürkün, O. 2007. Creative Thinking in Schizophrenia: The Role of Executive Dysfunction and Symptom Severity. *Cognitive Neuropsychiatry 12*(3), 235–258.

Barthes, R. 1977. The Death of the Author. In R. Barthes, *Image Music Text* (trans. S. Heath), London: Fontana. (Original work published 1967.)

Boden, M. A. 1990. *The Creative Mind*, London: Weidenfeld and Nicholson.

Boden, M. A. 2009. Computer Models of Creativity, *AAAI AI Magazine 30*(3), 23-33.

Casti, J. L. 1989. *Paradigms lost: Images of man in the mirror of science.* New York: William Morrow & Co.

Chordia, P., & Rae, A. 2010. Tabla Gyan: An Artificial Tabla Improviser, *Proceedings of the International Conference on Computational Creativity: ICCC-X,* Lisbon, Portugal.

Cohen, H., 1981. On Modeling of Creative Behavior. Rand Corporation Report Series, P-6681.

Colton, S., 2008. Creativity versus the Perception of Creativity in Computational Systems. *Proceedings of the AAAI Spring Symposium on Creative Systems.*

Cropley, D.H., Kaufman, J.C., Cropley, A. J. 2011. Measuring Creativity for Innovation Management, *Journal of Technology Management & Innovation 6*(3), 13-30.

Csikszentmihalyi, M. 1996. *Creativity: Flow and the psychology of discovery and invention.* New York: Harper-Collins.

de Bono, E. 1975. *New Think: The Use of Lateral Thinking in the Generation of New Ideas.* New York: Basic Books.

Gladwell, M. 2009. *What the Dog Saw and Other Adventures,* London: Allen Lane.

Glicksohn, J. 2011. Schizophrenia and Psychosis. In M.A. Runco & S.R. Pritzker (Eds.) *Encyclopedia of Creativity, (2nd ed.),* New York: Academic Press.

Goodman, N. 1978. *Ways of Worldmaking.* Indianapolis, IN (USA): Hackett Publishing.

Gordon, W.J.J. 1961. *Synectics: The Development of Creative Capacity.* New York: Harper & Row.

Harry, H. 1992. On the role of machines and human persons in the art of the future. *Pose 8,* 30–35.

Holstein B.I. 1970. *Use of Metaphor to Induce Innovative Thinking in Fourth Grade Children.* Ph.D. thesis, School of Education, Boston University, Boston, Mass.

Horn, D. and Salvendy, G. 2006. Consumer-based assessment of product creativity: A review and reappraisal. *Human Factors and Ergonomics in Manufacturing & Service Industries 16*(2), 155-175.

Indurkhya, B. 1997. On Modeling Creativity in Legal Reasoning. *Proceedings of the Sixth International Conference on AI and Law,* Melbourne, Australia.

Indurkhya, B. 2007. Creativity in Interpreting Poetic Metaphors. In T. Kusumi (Ed.) *New Directions in Metaphor Research,* Tokyo: Hitsuji Shobo.

Indurkhya, B. 2010. On the Role of Metaphor in Creative Cognition. *Proceedings of the International Conference on Computational Creativity: ICCC-X,* Lisbon, Portugal.

Indurkhya, B. to appear. Computers and Creativity. In C. Forceville & T. Veale (eds.) *Agile Mind,* Mouton.

Indurkhya, B., Kattalay, K., Ojha, A., & Tandon, P. 2008. Experiments with a Creativity-Support System based on Perceptual Similarity. In H. Fujita and I. Zualkernan (eds.) *New Trends in Software Methodologies, Tools and Techniques,* Amsterdam: IOS Press.

Ishii, Y., Indurkhya, B., Inui, N., Nose, T., Kotani, Y., & Nishimura, H. 1998. A System Based on Rodari's 'Estrangement' Principle to Promote Creative Writing in Children. *Proceedings of Ed-Media & Ed-Telecom 98,* Freiburg, Germany.

Kaufman, J.C., & Beghetto, R.A. 2009. Beyond Big and Little: The Four C Model of Creativity. *Review of General Psychology 13*(1), 1–12.

Kozbelt, A. 2005. Factors Affecting Aesthetic Success and Improvement in Creativity: A Case Study of the Musical Genres of Mozart. *Psychology of Music 33*(3), 235–255.

Krzeczkowska, A., Colton, S., & Clark S. 2010. Automated Collage Generation – With Intent. *Proceedings of the International Conference on Computational Creativity: ICCC-X,* Lisbon, Portugal.

Kurzweil, R. 2001. *Cybernetic Poet.* http://www.kurzweilcyberart.com/poetry/ Last accessed on 29 January, 2012.

López, A.R., Oliveira, A.P., & Cardoso, A. 2010. Real-Time Emotion-Driven Music Engine. *Proceedings of the International Conference on Computational Creativity: ICCC-X,* Lisbon, Portugal.

Maduro, R. 1976. *Artistic creativity in a Brahmin painter community.* Berkeley, CA: Center for South and Southeast Asian Studies.

Maher, M.L. 2010. Evaluating Creativity in Humans, Computers, and Collectively Intelligent Systems, *DESIRE'10: Creativity and Innovation in Design,* Aarhus, Denmark.

McCorduck, P. 1991. *Aaron's code: Meta-art, artificial intelligence, and the work of Harold Cohen.* New York: W. H. Freeman.

Monteith, K., Martinez, T. & Ventura, D. 2010. Automatic Generation of Music for Inducing Emotive Response. *Proceedings of the International Conference on Computational Creativity: ICCC-X,* Lisbon, Portugal.

Ni, Y., Santos-Rodriguez, R., Mcvicar, M., & De Bie, T. 2011. Hit Song Science Once Again a Science? Presented at the *4th International Workshop on Machine Learning and Music: Learning from Musical Structure,* Sierra Nevada, Spain.

Painter, K. 2002. Mozart at Work: Biography and a Musical Aesthetic for the Emerging German Bourgeoisie. *The Musical Quarterly 86*(1), 186–235.

Pérez y Pérez, R., Negrete, S., Peñalosa, E., Ávila, R., Castellanos, V., & Lemaitre, C. 2010. MEXICA-Impro: a Computational Model for Narrative Improvisation. *Proceedings of the International Conference on Computational Creativity: ICCC-X,* Lisbon, Portugal.

Ramachandran, V.S., & Hirstein, W. 1999. The Science of Art: A neurological theory of aesthetic experience, *Journal of Consciousness Studies 6*(6-7), 15–51.

Rodari, G. 1996. *The Grammar of Fantasy* (J. Zipes, Trans.) New York: Teachers & Writers Collaborative.

Runco, M.A., & Kim, D. 2011. The Four Ps of Creativity: Person, Process, Product and Press. In M.A. Runco & S.R. Pritzker (Eds.) *Encyclopedia of Creativity, (2nd ed.),* New York: Academic Press.

Sacks, O. 1995. *An Anthropologist on Mars: Seven Paradoxical Tales.* New York: Alfred A. Knopf.

Sawyer, K. 2006. *Explaining Creativity.* Oxford University Press.

Shapira, O., & Liberman N. 2009. An Easy Way to Increase Creativity. *Scientific American (Mind Matters),* July 21, 2009.

Singh, S. 2004. *Big Bang.* New York: Harper Collins.

Szabo, G., & Huberman, B.A. 2010. Predicting the Popularity of Online Content. *Communications of the ACM 53*(8), 80–88.

Wegener, A. 1966. *The origin of continents and oceans (4th ed.)* (trans. J. Biram), London: Dover (Original work published 1915.)

Zeki, S. 2000. *Inner Vision: An Exploration of Art and the Brain.* Oxford (UK): Oxford University Press.