Ryan Roberts
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The walls of the Louvre are covered with artistic masterpieces, widely recognized as some of the most treasured, creative works known to man. The unique stroke of a brush or the layering of paint can distinguish these geniuses from the masses. Despite the ability to label these pieces of art as especially creative, it remains unclear how one can truly qualify the defining characteristics of creativity. This faculty is commonly viewed as intangible, as 'a spark of creativity,' or, 'a flash of creativity.' This phenomenon, which lies at the foundation of our artistic culture, eludes our current grasp of understanding. For some, creativity rests within our human nature as an integral part of our being, for others, it may emerge from the great mechanical complexity of our brains, or the randomness of the universe. In recent years there have also emerged visual and literary works by computers which some experts believe to have a creative nature. This controversial idea causes unease in many that characteristics we commonly assume to be innately human could manifest in a machine. However, after viewing the works created by computers, it becomes necessary to consider the possibility of such creative ability whether or not the works themselves are creative. In

my paper, I will explore the possibility of computer creativity through a contrast with human creativity, current examples of possible creative works by computers, and recent theories concerning how this can be achieved.

Though one can find examples of human creativity in nearly all aspects of life, perhaps it is most clearly evident in our literature. The thoughtful combination of words can express the gauntlet of human emotions and experiences aptly, and in the most talented of authors, can breathe life into the words and seemingly recreate the experiences in the mind of the reader. Notable and critically praised author James Joyce provides an example of this in his work *Ulysses*:

> As we, or Mother Dana, weave and unweave our bodies, Stephen said, from day to day, their molecules shuttled to and fro, so does the artist weave and unweave his image. And as the mole on my right breast is where it was when I was born, though all my body has been woven of new stuff time after time, so through the ghost of the unquiet father the image of the unliving son looks forth. In the intense instant of imagination, when the mind, Shelley says, is a fading coal that which I was is that which I am and that which in possibility I may come to be. So in the future, the sister of the past, I may see myself as I sit here now but by reflection from that which then I shall be (Joyce 186-7).

Joyce's ability to produce creative analogies shines through in this passage; though Stephen's physical characteristic of the mole on his chest remains the same, he declares that his "body has been woven of new stuff time after time." This analogy of the physical characteristics of his body through time is a deep insight into the contrast between the ever-changing individual and

the continuity of a human being's identity throughout his lifetime. Not only does he express an insight into

human nature, which is far from readily obvious, he creatively uses powerful imagery, such as 'the ghost of the unquiet father,' which strikes the reader, painting clear pictures of seemingly intangible subjects.

While Joyce masterfully provides examples of these basic characteristics of literature, the more controversial William Faulkner provides an alternate creative style. In his novel, *The Sound and the Fury*, he melds stream-of-consciousness with normal prose to present an intensely emotionally-charged work.

Peering into the mind of one of the characters, the reader witnesses:

> Hats not unbleached and not hats. In three years I can not wear a hat. I could not. Was. Will there be hats then since I was not and not Harvard then. Where the best of thought Father said clings like dead ivy vines upon old dead brick. Not Harvard then. Not to me, anyway. Again. Sadder than was. Again. Saddest of all. Again. (Faulkner 95).

At first glance, the incomplete sentences, and the random word order in parts render the reader confused and unsure of how to comprehend the passage. However, when one thinks about something, or internalizes an experience, one doesn't normally think in complete, coherent sentences. Words flash into the mind as quickly as images are presented, sometimes singly, and sometimes fragmented. Faulkner exemplifies creativity with his stream-of-

consciousness dialogue, and further when he successfully transcends age and gender barriers later on in the text, as he assumes the characters of men and women, young and old. He demonstrates creativity and though his style of writing differs from Joyce, he still retains the ability to reach the reader on an emotional level.

With these literary giants in mind, it appears that a computer program could never reproduce such techniques with any authenticity; without the emotion or experience of a human which seem crucial to the creative process, such a feat appears impossible. However, recent computer programs have been able to produce output that has convinced many experts of the possibility of computer creativity (Picard 39). One example of this is an excerpt from a book written by the computer program 'Racter.' The computer writes:

> He wished to assassinate her yet he sang, 'Lisa, chant your valuable and interesting awareness.' Lisa speedily replied. She desired possessing her own consciousness 'Benton,' she spoke, 'you cry that war and assault are a joy to Diane, but your consciousness is a tragedy as is your infatuation. My spirit cleverly recognizes the critical dreams of Benton. That is my pleasure.' Benton saw Lisa, then began to revile her. He yodeled that Lisa possessed an infatuation for Diane, that her spirit was nervous, that she could thoughtfully murder her and she would determinedly know nothing. Lisa briskly spoke that Benton possessed a contract, an affair, and a story of that affair would give happiness to Diane. They chanted sloppily for months. At all events I quickly will stop chanting now
> (Hofstader 471).

After reading this passage, it appears possible that one could perceive this as creative work. The computer touches on subjects which seem so innately human and personal, such as desire, infatuation, and nervousness, that it takes the reader aback. Not only does the computer reference such human emotions, it also exhibits an ability to use a fairly extensive vocabulary in conjunction with a surprising command of English grammar which many people seem to lack.

These modern examples of computer creativity are not only limited to prose, but also appear in the complex world of poetry. While it may seem easy to explain away the creative nature of the above computer-generated passage by virtue of it being a program, written by humans, which clearly expresses grammatical laws and provides vocabulary, poetry seems to be in a separate realm. Poetry isn't bound by any strict laws which may easily be programmed into a computer, and, perhaps even more than prose, seems so intensely personal that it provokes one to ask, "How could a computer possibly express anything remotely to the effect of human poetry?" It may be surprising, then, when one reads this sampling of a computer-generated poem:

> I do not know the answer to the question
>
> There was a time when moorhens in the west
> There was a time when daylight on the top

There was time when God was not a question

There was a time when poets
Then I came (Boden 8).

These incomplete sentences call to mind the stream-of-consciousness that Faulkner so successfully adopted as a means to communicate creativity in his own work. They also seem to compel the reader to postulate the 'question' that the computer mentions, which allows the words to reach the reader on a personal level. Furthermore, it speaks to the reader's own experience of introspection about nature and God, which removes it further from the cold realm of computer programming, consisting of binary operations of ones and zeroes. There is also an interesting reference in the last line to something that seems like self-awareness. Though self-awareness is not clear evidence of computer creativity, it again adds a human dimension to the poetry, which lends credibility to the possibility of its creative ability.

Now armed with the examples of both human and computer-generated writing, it becomes necessary to discuss current theories of creativity which are relative to the study of artificial intelligence. Two such common theories are that the nature of creativity has a foundation in the ability to create possibilities and recognize the profound, another is the ability to reshuffle the old into the new. When discussing how to implement the first criteria for

creativity into an artificial intelligence program, Hofstadter, an artificial intelligence researcher, declares that “full-scale creativity consists in having a keen sense for what is interesting, following it recursively, applying it at the meta-level, and modifying it accordingly” (Hofstadter 313). Though this is not easy to apply in a computer model, this is an essential component of human creativity. This is easily seen in math where there are an infinite number of relations, yet mathematicians have an uncanny ability to recognize the profound. Though they seem commonplace today, correlations such as the Pythagorean Theorem and pi, the ratio of any diameter of a circle to its circumference, were picked out of an infinite number of other less significant relations.

The second criterion of intelligence can be easily traced throughout all of literary and art history. With this concept in mind, it has been said by many before that “all finding is refinding” (Singer 47). Not only does this apply to artificial intelligence systems, but it is also widely seen in human ingenuity. For example, famous beat author Jack Kerouac, by using the style of stream-of-consciousness, borrows from previous authors such as Faulkner, and it has been said that all modern novels find their source in Cervantes’ *Don Quixote*. Though this reshuffling of old ideas is common, the Jack Kerouac’s of the world are nonetheless admired for their creativity.

With the current theories of creativity in mind, and the examples of human creativity and possible computer creativity we have seen, we will now determine whether there is sufficient basis to consider whether or not each of them truly displays creativity. While the idea of a computer, merely a machine, possessing creative abilities may seem questionable, it is important to ask whether our processes of creativity are the same. Initially, it seems as though these processes are clearly not the same. We do not, and seemingly cannot, know how the creative aspects of our brain work. This has been observed many times before, and was explained by Francois Jacob, a molecular biologist, as follows:

> Day science employs reasoning that meshes like gears…One admires its majestic arrangement as that of a da Vinci painting or a Bach fugue. One walks about it as in a French formal garden…Night science, on the other hand, wanders blindly. It hesitates, stumbles, falls back, sweats, wakes with a start. Doubting everything…It is a workshop of the possible…where thought proceeds along sensuous paths, tortuous streets, most often blind alleys (Boden 113).

In this poetic definition, Jacob refers to the methodical part of science, the part in which current computers can perform, as day science, and the realm of innovation and creativity as night science. Given this vivid description of a creativity that is well outside the constraints of a strict program, it seems as though any computer could not possibly exist in the "workshop of the possible," where Jacob believes that human creativity resides. One expects

this because the standard approach to computation involves following strict guidelines in a program, and this is clearly not what the brain is doing as it proceeds along its "sensuous paths." As a result of this, the reader may determine that computers are not truly creative simply due to the fact that they operate under a list of constraints set by a programmer.

Singer also seems to argue against computer creativity based on the fact that humans learn in an entirely different way than computers, and that this prevents them from truly being creative. It seems that the standard approach to the way that people learn and develop appears limited, based on the ideas of artificial intelligence computer models. Singer feels that these cannot possibly accurately describe, emulate, or reproduce the human mind. As such, there must be something different taking place within us. Singer feels that this may lay in the fact that we not only affect our outside environment, but that our outside environment affects us as well. It is a reciprocating process of growth which allows the human mind to exist as it does. He feels that this cannot possibly exist in computers because they are a set of unchanging and inadaptable pieces of hardware. At best, they are a feeble, potential mind, chained and held back by the cage of metal and silicon. Singer feels that this restriction may be the definitive difference in

determining whether or not computers and humans ‘think’ alike, and consequently, whether they can be considered creative.

The idea of comparing the creativity of a machine operating under definite restrictions to the creativity of a human, which we like to imagine remains free from such shackles, may seem unimaginable. However, some may argue, namely researchers involved in artificial intelligence, that brains are like one sort of computer-model: a connectionist system or neural network, one that most people are not familiar with on a day to day basis. These connectionist systems are used for neuro-scientific research and they are modeled on the brain. In fact, these systems have been shown to have an “associative memory,” which has both a meaningful and contextual basis (Boden 119). More importantly these systems perform these meaningful and contextual associations by themselves, without being specifically programmed to do them. As Boden explains, “rather, their associative memory and tantalizing, human-like, capacities are inevitable results of their basic design” (120). An example of school children learning clearly demonstrates this humanistic characterization. For instance, when trying to learn, or at least recognize, what an apple is, though every apple the child sees differs slightly than the one before, a connectionist process is used. Initially, the child knows nothing of the concept of an apple and can solely

recognize color and shape contours. Most likely the child will make wrong guesses as to what the object is, and will either be corrected by the teacher or society. This process alters their brain, and results in the storing of this information much as a connectionist system would. This process continues until this child has a near perfect knowledge of and ability to recognize the apple. This associative process in human learning is directly mirrored in neural net systems and is capable of feats today such as defeating world chess champions, and some believe the capability of creative thought in the future (Boden 120).

Boden again maintains that these connectionist systems are plausible models of genuine creativity through further comparison of human and computer thought-processes. She attacks the argument that computers are prevented from achieving creativity by acting within restrictions. She relates that "artistic [human] creativity, likewise, often involves such reasoning. 'Anything goes!' is not a good motto for the arts. We can enjoy a disciplined integration of a Bach fugue and jazz-style, but we would not appreciate just any fuzzy mix of melodies" (132). Clearly, even the ingenious musical or visual artist's creativity operates in some boundary, as does a connectionist network. It seems then that the fact that computers act from within some basic constraints does not necessarily exclude them from the creative realm.

Now that the possibility of computer creativity, and the similarities between human and computer creative processes, has been analyzed, the task is now to determine whether the specific examples cited above of the computer-poet and Racter are truly examples of creativity. Even philosophers who remain skeptical concerning the possibility of computers achieving human capabilities define imagination and creativity in a way that these computer-generated passages exemplify. Concerning the nature of imagination in poetry, Irving Singer declares:

> When people speak 'poetically,' whether or not they are poets, they often make statements that are nonsensical as literal discourse but are meaningful all the same. What is sensically conveyed is a general feeling about the matter at hand, a feeling that obliquely expresses a wide range of feelings or emotions that someone may experience. This capability derives from imagination and, above all, from the process that defines the imaginary (Singer 50).

This definition of imagination, which is closely tied to the ability to be creative, seems to fit the two computer excerpts above. In both cases it appears that what has been "sensically conveyed" is "a feeling that obliquely expresses a wide range of feelings or emotions that someone may experience." In Racter's piece, this is achieved through the topics of assassinations, affairs, infatuations and dreams. In the case of the computer-poet, there is a direct reflection on the question of God, of knowledge, and one's own effect on external reality. All of these concepts speak deeply to

the human spirit, yet the question still remains whether these passages represent true examples of creativity possessed by a computer, or just merely its false appearance seen in the rare result of a highly sophisticated program.

Though many artificial intelligence experts maintain that these passages are examples of true computer creativity, or proofs that this is possible in the future, there are grounds for skepticism. For one, these computer programs which produce the poetry cited above are a conjunction of a random number generator to simulate the high variability of the human mind with a primitive ability to choose interesting combinations of the random variations. In this case, because the selection program is so primitive most of the choosing of the significant material produced is done by the human. This makes these examples of computer creativity not too impressive because a major portion of the creative process, the recognition that what one produces is interesting or creative was done by the human.

This is not necessarily the death of computer creative potential. An associative learning computer may in time develop this ability and may even surpass our own. For example, a child must be trained and conditioned through associative learning to recognize significance and few people actually develop this process along with the conjunction to develop the interesting ideas in the first place to be called creative (Hofstadter 470).

Thus far there is still potential for the creative computer. However, there is another phenomenon which was first discovered in relation to the human interpretation of computer output: the Eliza effect. Hofstadter defines this as the “susceptibility of people to read far more understanding than is warranted into strings of symbols – especially words – strung together by computers” (157). This process was first discovered and recognized after the creation of program ELIZA in the mid 1960’s. ELIZA was originally designed to act as a psychotherapist that responded to “typed lamentations” of patients with fairly unoriginal questions or requests such as, “please go on.” Surprisingly, even though this program has no creative component by any stretch of the imagination, it convinced many people that it actually understood and empathized with their situations. This “effect” is a serious problem which must be taken into consideration when determining the creative ability of a computer.

With that thought in mind, the interpretation of the two computer excerpts presented previously takes on new meaning. It seems reasonable that when we are presented with a string of words written in a manner to emulate what a human writer or poet would produce, we would naturally try to understand the creative and emotional processes the author experienced to produce these. It is interesting to note that Singer shows that this has been

seen before in respect to the relationship between the human artist and his readers. He relates, “But more significant, I think, is the fact that no fictional character, however suitable for love or suggestive as a sexual object, can have its effect upon members of an audience unless, to paraphrase Shakespeare, they upon their imaginary forces work” (Singer 133). It appears, then, that this Eliza effect, which is often thought of being deadly to the viability of creative computers, may actually be an integral part of the creative process whether human or machine.

So far, the debate as to whether computers are capable of creativity, and particularly whether the two examples of computer literary art previously discussed are creative, has centered on the insufficiencies of computer models to represent the human creative process. However, there are those who oppose even the possibility of computer creativity not because they believe the computer models are insufficient, but because they believe the faculty of creativity is innately human and could not exist otherwise. Singer, for one, holds this view of imagination and creativity, stating:

> In its role within imagination, the imaginary is typically and distinctively human. It requires an intellectual capacity that exceeds the mental equipment of all other creatures on earth…A dog who sees his master put on an overcoat will make preliminary movements as if he thinks it is quite possible the two of them may be going for a walk. The dog could be said to ‘entertain’ this and other possibilities, to keep them ‘in mind.’ But we have no reason to think that he has a concept of possibility (Singer 49).

I do not, however, believe that this is a sufficient argument that computers cannot have an imaginary and creative ability on par or superior to man. Perhaps a computer model of the future may be excellent at making creative analogies unseen by humans, or even more probable, the ability to make interesting mathematical or scientific insights that have eluded man for centuries. Despite this, the computer may not be said to have human creativity; its existence is not similar to our own. We are living organisms who have a fundamental place on this earth, and this is deeply-seeded in our most basic mental "machinery." A computer, on the other hand, is trapped inside a cold and mechanical silicon-based frame, which cannot interact with its outside environment. These drastic differences alone are enough to convince some that computers can never possibly attain a creativity comparable to the likes of human creativity. However, this does not rule out a computer creative ability which may be different, but creative nonetheless.

After reviewing the arguments for and against the possibility of computer creativity, evidence suggests that current computers are not creative. However, I do not believe that the arguments stating that computers are incapable of creativity, such as those that cite an impenetrable barrier between our creative processes and that of any hypothetical artificial intelligence design, or simply that creativity is uniquely a human

phenomenon are definitive. Though artificial intelligence systems may not produce human creativity, there is the possibility that there can be a creativity different, yet perhaps more effective than our own. Some may still find it hard to believe in a future computer which could paint like Monet, or have faith in a machine to effectively speak to the emotions of a human. However, technological innovations continually astound us, and it is no less plausible that a computer could function at this level of creativity, than one hundred years ago to imagine men landing on the moon.

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