CREATIVITY, CHARACTERS AND INFLUENCES OF THE LITERARY GENIUS

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Knowledge is Our Business

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CHAPTER 1

EXPLORING THE MYSTERY OF THE CREATIVITY

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ABSTRACT:

It is possible to differ on whether a certain concept or person qualifies as innovative. Your boss's humor or your roommate's cookery can be over limits. You may recoil at the Marx or Saatchi brothers. You might argue that, among other people, Darwin's own grandpa knew the concept of evolution long before he did. You may even complain that Plutarch provided the inspiration for Shakespeare's storylines, Bach exploited Vivaldi's tunes, or Picasso modified Velasquez artwork. But it's difficult to deny that innovation does sometimes occur. It is mysterious how it occurs. This should not mean that it is fundamentally difficult to explain creativity in terms of science, since scientists are used to solving riddles. But mysteries are different. If a mystery is a question that can hardly be posed, much less effectively answered, a puzzle is an unanswered inquiry. Science cannot solve all mysteries. Since there is something paradoxical about creativity that makes it difficult to understand how it is even possible, it seems to be a mystery.

KEYWORDS:

Computer, Creativity, Human, Mystery, Question.

INTRODUCTION

Shakespeare, Bach, Picasso, Newton, Darwin, Babbage, the Saaths, Groucho Marx, and the Beatles are just a few examples decide which. The creative community is diverse, including poets, scientists, marketers, and fashion designers. Consider your friends or family members; chances are you may remember their creativity as well. No jokes up to Groucho's standards, maybe, but at least a little wit or sarcasm? Maybe they can play jazz improvisations on the piano in the living room or sing their own descants to hymn tunes? What about their resourcefulness when it came to creating a fancy-dress outfit or repairing a broken car?

Mysteriously Deep

If the dictionary's definition of creation "to bring into being or form out of nothing" is taken literally, then creativity seems to be not just unachievable but downright impossible. No engineer or skilled worker ever created a creation out of nothing. And sorcerers (or their apprentices) who create objects like brooms and buckets out of thin air do so via occult magic rather than any logical method. Thus, the "explanation" of creativity is reduced to either magic or denial [1], [2].

The issue extends beyond only material production. It doesn't really assist to define creativity psychologically as "the production of new ideas." Because how else might novelty be explained? Either the thing before it was comparable, in which case the innovation is little. If it wasn't, it's impossible to see how the novelty could have come about. Once again, our options are magic or denial. It seems that a psychological explanation of creativity is theoretically impossible. Even the possibility that it may explain anything is unclear. And yet there is, without a doubt HILosoHErs and TheoLoIANs have long been aware of the contradictory nature of the idea of creation. They said that even God couldn't create anything ex nihilo (from of nothing) two thousand years ago. They asserted that not only had God created the cosmos, but the enigma is not resolved by this finding. It seems that the cosmos has ('new') qualities that God does not. In order to determine whether it was metaphysically feasible for an immaterial God to create a material cosmos, mediaeval theologians of Christianity, Judaism, and Islam as well as their successors during and after the Renaissance tirelessly discussed the issue. As in the past, some thinkers today have come to the conclusion that it is simply not possible: either there is no creator-God (and no creation), or the one who created nature somehow shares its characteristics. Can we genuinely talk of creation, however, if the creator also has such qualities? There can be no creation if there is no fundamental difference between the creator and the produced. For this reason, according to Christian faith, Christ was "begotten, not created" a phrase that appears in a well-known Christmas carol because He is indivisible from God [3], [4].

In essence, the dilemma still exists. Despite its difficulties, the creation of the cosmos may be entrusted to the care of theologians and cosmologists. What about human creativity, whether it be sporadic (the boss's one clever comment) or consistent (Mozart's lifetime of music)? There is nothing more comfortable. Surely psychology should be able to explain this? But there are also issues with human inventiveness. For example, it doesn't merely surprise people; it also seems to be innately unexpected. A scientific psychology of creativity is a contradiction in words if, as many people think, science demonstrates the capacity for prediction. Anyone who asserts that creativity can be understood scientifically must thus explain how creativity is unexpected and why this predictability does not firmly ground creativity in the depths of mystery.

Numerous related issues centre on how new an innovation must be in order to qualify as creative. Randomness offers novelty (and unpredictability), therefore is chaos in and of itself creative? What separates creativity from craziness is there novelty in madness too? People are capable of having unique ideas in comparison to their prior ones. Is everything banality that an adult has just realised, and a lot of what a small kid accomplishes, to be considered creative? Ideas that have never been thought of before are possible for people. Does it count as creativity if I state that the Tower of London is home to 33 blind, purple-spotted enormous hedgehogs something no one else has ever been so foolish as to suggest?

Imagine a scientist or mathematician comes up with an invention that garners a prestigious international prize, only to discover later that a self-taught crossing sweeper came up with it first. Is this even conceivable, and if so, does it impair the winner's originality? What about the ability to recognise novelty? If a concept is fresh, why does it sometimes take people a while to recognise it as such? What about social acceptance? Does this have anything to do with creativity, and if so, does this imply that psychology alone, unaided by either the sociology of knowledge or the history of ideas, is unable to explain it? These questions have a philosophical feel to them because they are philosophical in nature and involve not just the 'facts' of creation but the idea itself. There are numerous fascinating questions concerning the facts of creativity, chief among them being how it really occurs. But many stubborn issues are, at least in part, a result of conceptual challenges in defining creativity and what qualifies as creative. Furthermore, the conceptual dilemma must be resolved before the factual problems can be resolved [5], [6].

DISCUSSION

Finding a definition of creativity that tames the contradiction is one goal of this work. Creativity may rationally be seen as a mental ability to be understood in psychological terms, as other mental abilities are, after we have subdued the contradiction and removed the mystery. This brings me to my second goal, which is to describe the various mental processes. The mental architectures on which human creativity is based, offering an explanation for the mystery of how creativity occurs. The contradictory character of the idea has an implicit influence on people's beliefs, which are very negative [7], [8].

About The Explanations Offered by Science

In fact, the adjective "pessimistic" may not be appropriate here. Many individuals take great joy in the idea that creativity is inaccessible to science. Two widely held perspectives I'll call them the inspirational and the romantic assume that creativity, the pinnacle of mankind, is exempt from the reductionist clutches of scientific explanation. Its magnificence is found in its incomprehensibility. Many people think that these opinions are literally true. But they are seldom put under close scrutiny. They serve to communicate the ideals, allay the anxieties, and support the customs of the society that celebrates them; they are not theories so much as imaginative constructs known as myths. The inspiring perspective considers creativity to be fundamentally enigmatic, maybe even superhuman or heavenly. A poet is holy and cannot write until he is overcome by inspiration, when reason leaves him and he is over himself, according to Plato Because of supernatural force rather than artistic ability, he speaks them.

Similar comparisons between Mozart and Salieri, a contemporary of his, were drawn in the drama Amadeus more than two hundred years later. In practically every part of his life, Mozart was portrayed as filthy, vulgar, slothful, and untrained, yet when he composed, he seemed to be inspired by a holy flame. Salieri was the foremost court composer (until Mozart came along) who, despite his success, only managed to accomplish a simply human competence in his music. He was a socially well-behaved and conscientious expert who was well-equipped with "reason" and "art" (i.e., skill). In his column for The Times, the London critic Bernard Levin made it clear that he believed Mozart, like other great artists, had received actual heavenly inspiration. If this point of view is accurate, then any attempt to scientifically explain creativity must be abandoned.

The romantic perspective is less extreme, contending that although not literally being divine, creativity is at least remarkable. According to popular belief, scientists and creative artists are endowed with a certain aptitude that others lack: insight or intuition. Romantics have only hazy assumptions about how intuitive insight truly works. They reject the idea that a scientific explanation for creativity could ever be found because they believe it to be essentially inexplicable. The romantic believes that intuitive ability is intrinsic, a gift that may be wasted but cannot be learned. This romanticism has a defeatist feel to it since it suggests that the only thing, we can really do to foster creativity is to recognize those who possess it and allow them space to express it. It's impossible to imagine how to promote creativity any more actively [9], [10].

Hymns to intuition or insight, however, are insufficient. According to psycho- logical theory, "insight" is the name of a question, and a question that is extremely ambiguously worded at that. Romanticism offers no insight on how to be creative. Arthur Koestler, whose description of creativity in terms of "the dissociation of matrices" (the juxtaposition of heretofore unrelated thoughts), is also a well-known perspective, who was really interested in how creativity arises, recognised this. As he said, the spontaneous appearance of a fresh understanding at the crucial time is an act of intuition. Such intuitions seem to be miraculous flashes or logical short-circuits. In reality, they may be compared to a chain that is submerged, with just the beginning and finish visible above the level of awareness. By using invisible links, the diver travels from one end of the chain to the other and then reappears.

Although an improvement over the pseudo-mysticism advanced by romantics and inspirationists, Koestler's own explanation of how this occurs is just suggestive. He gave a basic overview of creativity but did not go into any specifics. His book picks up where Koestler left off on the subject of creativity. It seeks to pinpoint some of the underlying "invisible links" As well as to describe how they may be tempered and fashioned, intuition. Therefore, the human mind and the functioning of intuition are my core concerns. How are fresh ideas even possible for people? The book's main argument is that concepts from artificial intelligence (AI) may help us understand these issues more clearly.

The study of how to create and/or programme machines with artificial intelligence computers to do tasks that only human brains are capable of, including as understanding English, recognising faces, finding items partially concealed in shadows, and providing advice on issues related to science, law, or medical diagnosis. A new method of researching the mind known as "computational psychology" has emerged as a result of the wealth of ideas it offers for potential psychological processes. I'll use a lot of computational concepts in my explanation of human creativity. People with little to no computer knowledge and even less interest in computers may understand them. They may be seen as a specific group of psychological concepts. As we will see, they aid in our comprehension of both what creativity is and how it might occur.His claim is one that both romantics and inspirationists ridicule and reject with contempt. If creativity comes from a supernatural or heavenly source, or if it mysteriously arises from some unique source.

Computers must be completely useless compared to human intelligence. Additionally, not only 'anti-scientific' romantics and inspirationists come to this conclusion. Even those who think psychology may one day be able to explain creativity (like Koestler, for example) often reject the idea that computing or computers might have any bearing on it. According to a common belief, computers cannot create since they can only carry out the tasks for which they have been programmed. Lady Ada Lovelace, a close friend of Charles Babbage whose mid-19th-century 'Analytical Engine' was essentially a design for a digital computer, was the first to present this idea. Countess Lovelace declared: "The Analytical Engine has no pretensions whatever to originate anything," while being sure that Babbage's Analytical Engine could, in theory, "compose elaborate and scientific pieces of music of any degree of complexity or extent." Any sophisticated pieces of music coming from the Analytical Engine would thus be attributed to the engineer rather than the engine since it can only do what we know how to instruct it to do.

If Lady Ada's statement simply implies that a computer is limited to the tasks that its software permits, then it is true and significant. However, it is too short and too simplistic if it is meant to refute any compelling connection between computers and creativity. Four different questions, which are often mixed together, must be distinguished. I refer to them as Lovelace-questions since the argument mentioned above is one that many people would use to refute them (with a dismissive "No!"). Whether computational concepts may aid in our understanding of how human creativity is possible is the first Lovelace question. The second is whether machines will ever be able to do tasks that at least resemble creativity (in the present or in the future). The possibility of a computer ever appearing is the third to recognise originality, for example, in poetry produced by human poets. The fourth question is whether computers might ever really be creative (as opposed to just creating seemingly novel performances that are entirely the product of human programmers). The first Lovelace-question, which emphasises human creativity, is the core topic of this book. The second and third Lovelace questions are less significant, unless they provide some information on the first. The fourth is the least significant of them all for the purposes of this book (and is only mentioned in the last chapter).

The first Lovelace question has a "Yes" answer. We can better grasp how human creativity works by using computational concepts. As we will see, this does not imply that originality is foreseeable or even that it can be completely explained after it has been generated. However, we may use computational concepts to describe in scientific terms how 'intuition' works. The second Lovelace question may also be answered "Yes," and I'll go on to detail some current computer programmes that could be considered innovative. Programmes that unquestionably seem inventive do not yet exist for the reasons I will outline.

Even if they did exist, the fourth Lovelace issue is focused on whether or not they were really innovative. I often refer to programmes that seem to be creative as simply creative without the use of scare quotes or the qualifier "appear to be. Anything else would be incredibly tiresome. But keep in mind that until the fourth Lovelace-question is covered in the last chapter, there won't be any concerns regarding computers being "really" creative. Sometimes these "creations" would be admirable if they were produced by humans in the customary manner, whatever that may be. I'll use the beautifully straightforward geometry argument that Euclid himself did not discover as an example. This apparent computer inventiveness is not only limited to strictly mathematical or even scientific circumstances. The image that appears in the frontispiece was created by a computer programme, but it is a photograph that I have in my office and that many visitors and coworkers have stopped to enjoy of their own will.

As we will see, modern programmes' literary efforts fall short in comparison. However, even these are not nearly as mindlessly "mechanical" as the first four stanzas of) this made-up computer poetry, which Laurence Lerner purportedly attributed to ARTHUR Automatic Record Tabulator but Heuristically Unreliable Reasoned Anthology of English Poetry by Arthur the dilemma of being or not being to explain to humans God's methods. Previously, the meadow grove and stream decreasing daylight hours in the west. Moorhens on top and otters below had collapsed around their Lord in Lyonesse. When moorhens were perched on top, Otters below and a meadow grove and stream, to be or not to be about their Lord Had fallen in Lyonesse from God to mankind, to justify the sunshine in the west. The question is which decline will occur today.

The era of Lyonesse, the grove, and the stream to be the sun's rays on top in the west. Meadow otters gathered around their Lord when the argument for the moorhens must be made. Alternatively, avoid dropping God to humans. The methods that are a time were below. The dilemma is whether to be in Lyonesse. The issue is: How can we defend the otters? What caused the meadows to disappear? I'm not aware of the response to the query. When moorhens first appeared in the west, there was a period when the top was lit up. God wasn't a question at one point in time. When poets used to write, I came along. The third Lovelace challenge emerges because some of the skills necessary for creativity itself are need in order to evaluate uniqueness. Salieri berates God angrily in Amadeus for endowing him with just enough musical ability to fully appreciate Mozart's brilliance but not enough to match it. Indeed, as we will see, the ability to critically evaluate is necessary for creativity as opposed to just being intriguingly mad. As a result, when asked the third question, most respondents respond similarly to those asked the second. Another of Lerner's poems, "The Life and Opinions of a Digital Computer," depicts the skeptic's emphatic "No." No computer could be a literary critic, of course, since no non-human machine could even understand human creativity, much less equal it. Lerner is a poet and critic, and his professional colleagues would certainly concur with his negative response to our third question.

In contrast, computer scientists may provide a totally different response. The father of computer science, Alan Turing, thought that programmes could one day be able to understand and even compose sonnets. Here is an example of how, in his future vision (the human speaks first), a machine may provide a literary performance that is indistinguishable from that of a human. In fact, this is science fiction. Our final question, however, is more about the theoretical viability of computer critique than its applicability. Even someone who agrees with Turing that such a computerised sonnet-scanner is theoretically possible may not think that it would ever be built in reality. (For example, I don't.) Shakespeare's other sonnets and the five poems that, together with Hamlet's speech, were as the basis for Lerner's ARTHURian collection are also enjoyable to human readers who can scan the phrase "Shall I compare thee to a summer's day?" To be able to do the same, a programme would need a wide range of information, not to mention sophisticated methods of appreciating its significance. Therefore, the question of "to justify the otters" cannot be asked.

What if computers, rather than us, recognized originality in their own performances? Could a computer verify that its intuition of the kind "Now I'm on the right lines!" was accurate? Well, if a computer can at least mimic creativity (as I have said), then it must have some capacity for self-evaluation. It may not always be able to distinguish between excellent and bad ideas, and it sometimes might get stuck or get fixated on a small issue. However, it would be in excellent (human) company in such situation. Therefore, my response to the third Lovelace-question is the same as my response to the first two. The First Three Lovelace questions are interconnected and address scientific truth and theory. Without any psychological explanation of what creative thought is, one cannot determine if a machine might seem to be creative or assess creativity. Since the first question is the focus of this book, someone who is interested in it will likely be interested in the other two as well.

If computers can really be creative, the fourth Lovelace issue is completely different (and, for our purposes, less fascinating). It involves contentious moral and metaphysical discussion. It calls into question, for instance, whether we would also decide to make a certain moral or political choice if we were presented with machines that met all of the scientific requirements for creative intelligence (whatever they may be). This choice equates to giving the computer dignity by giving it a moral and intellectual regard that is akin to the respect we have for other people. I would probably respond "No" to the fourth question for the reasons that are discussed in the last chapter. Possibly you might as well. However, this hypothetical moral deliberation over made-up artificial animals has little bearing on our primary objective, which is to comprehend human creativity. Because the affirmative responses to the first three Lovelace questions may be true even if we respond "No" to the fourth.

In conclusion, whether or not computers can really be creative, they can do things that seem to be creative, and, more importantly, thinking about how they do this may help us understand how creativity occurs in humans of course, programmability isn't the only aspect of computers that causes people to question their value to creativity. They are executed rather than embodied, for starters. Not formed of flesh and blood, but of metal and silicon. Turing's hypothetical dialogue could therefore not be conceivable after all. Because of the sneezing and chilblains, we all suffer on a regular basis, and because we all like excellent food and good company, Christmas Day and Mr. Pickwick make for a particularly amicable contrast. However, this 'embodiment' criticism only applies to certain types of creativity and not creativity as a whole. The indifference of a computer to cold weather may compromise its artistic sensibility, but not its inventiveness in science or mathematics [11], [12].

CONCLUSION

The scientific truth that human intuition, compared to inspirations, is vital to creativity in general is more pertinent since it depending on the brain of a person. But compared to brains, computers are fundamentally different. Those who reject the idea that machines are capable of emulating or appreciating human creativity often make this argument. These individuals assert that even the mere association of the ideas let alone the experiences of winter and Mr. Pickwick necessitates the use of mental faculties or information processing, which computers lack. Later on, it will be addressed just what these brain-supported capacities of thought are and if they really are completely unrelated to computers and computational psychology. We'll demonstrate that the differences between computers and brains do not render them unimportant for comprehending creativity. Even 'traditional' work in computer science and artificial intelligence is relevant. Furthermore, modern "connectionist" computers are more brain-like than the device your gas company employs to generate its bills and better (for example) at recognizing parallels, which undoubtedly have an impact on creativity.

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CHAPTER 2

EXPLORING THE IMPORTANCE OF CREATIVE WORDS AND CHARACTERS

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ABSTRACT:

The three words "bath, bed, and bus" sum up what the creative types have revealed to us about how they come up with their ideas. Archimedes exclaimed, "Eureka!" as he sprinted through the streets of Syracuse after leaping from his bath.as he moved. How to calculate the volume of an item with an irregular form, such as a golden (or not so golden) crown, had been a conundrum that had troubled him for days. He had now found the solution. While snoozing by the fire, Friedrich von Kerulen had a dream that may have revealed the benzene molecule's problematic ring shape. As a consequence, aromatic chemistry as a field of study was established. Numerous times, the mathematician Jacques Hadamard discovered the long-sought answer "at the very moment of sudden awakening." And Henri Poincare, who had been fascinated with a particular class of functions for days, suddenly realized a basic mathematical feature of the group as he boarded a bus to go on a geological trip. These (and several more instances) demonstrate that creative ideas often occur while a person is either not thinking at all or seems to be thinking about something else.

KEYWORDS:

Anticipate, Atoms, Conscious, Creativity, Story.

INTRODUCTION

Poincaré was eagerly anticipating his excursion to explore the sights while Archimedes was relaxing in his bath. Hadamard was sound asleep in bed while Kekulé was dozing off beside the fireplace. When Marcel Proust was overtaken by the memories that inspired him to write his famous work, he was taking part in the most insignificant of activities eating cake. In an opium-induced dream, Samuel Taylor Coleridge saw a lyrical vision of Xanadu. The new concepts in this situation were transient and readily forgotten by being distracted. If the 'person on business from Porlock' hadn't knocked on Coleridge's cottage-door, the chilling vision of Kubla Khan, with its breath-taking blend of sweetness and ferocity, would have been even richer. From THE creator's perspective, intuition is a mystery. It may sometimes be described as a rapid flash of understanding without any immediately prior thoughts. A good example of this is Hadamard, who said, "On being very suddenly awakened by an external noise, a solution long sought for appeared to me at once without the slightest instant of hesitation. “thinking on my part".

Occasionally, a little bit more may be stated. For instance, the following is Kekulé's description of how, in 1865, he came to his understanding of benzene I slept while turning my chair towards the fire. Once again, I could see the atoms tumbling before my eyes. The smaller groupings behaved modestly this time around. My mental sight, sharpened by several experiences of this kind, could now see bigger structures of various shapes, lengthy rows that were sometimes fitted closer together, and which were all twining and twisting in a snakelike pattern. But observe! And what was that? A snake had grabbed hold of its own tail, and the mocking shape spun before my eyes. I awakened as though by a flash of light. Here, let's just say that it wasn't an unusual occurrence. Kerulen had previously experienced similar events, which is why he mentioned having "repeated visions of this kind." One of them had happened almost ten years previously. Kerulen was struggling with how to accurately convey the intricate interior structure of molecules at the time [1], [2].

I was heading home by the last omnibus [buses again!] one lovely summer evening.], 'outside' as usual, along the desolate city streets that are sometimes so bustling with activity. I was daydreaming when suddenly, behold Previously, the atoms were idling my sight. Until that point, I had never been able to determine the nature of the movements of these little things whenever they had previously come to me. Now, though, I saw how often a pair of smaller atoms formed from two bigger ones, how still larger ones held onto three or even four smaller ones, and how the whole system continued to spin wildly. I saw how the bigger ones connected in a chain. I spent a portion of the night sketching out these dream shapes on paper [3], [4].

Kekulé created a novel account of molecular structure, in which each individual atom could be identified in relation to all of the other component atoms, in part as a consequence of this bus-borne daydream. He implied that organic molecules were built on chains of carbon atoms by doing this. As you can see, the 'bigger atoms' of carbon are in fact 'embracing' the ‘smaller' atoms. There is a 'pair' formed by two hydrogen atoms. Additionally, a brief 'chain' made of two carbon atoms is connected by other molecules. Kekulé (who had studied architecture before switching to chemistry) plainly placed a high value on visual images. Coleridge also thought it to be vital. However, few assessments on creativity include any images. They only remember the problem's answer emerging out of nowhere after the person had been struggling to find it for a while. The solution's abruptness is not its sole peculiar quality. The response to the previous query might take a surprising form, according to Hadamard, who recounts waking up with a solution "in a totally different direction than any of ones that I'd previously attempted to imitate. There may sometimes seem to be no preceding inquiry, or at the very least, no prior asking. Picasso, for instance, said, "Je ne cherche pas, je trouve," suggesting that he had no expectations and could improve his work without considering his surroundings.

As usual, Picasso used the first person. However, other people have denied personal ownership of the work, or at least of a major portion of it. For instance, the author William Golding disputes that he was inspired by the scene in The Lord of the Flies when the kid hiding in the bushes is addressed by the pig's severed head. Instead, he simply states, "I heard it," adding, "The author becomes a spectator, appalled or delighted, but a spectator,"4 during such times. What should we take from this? Even if the phrase "sudden illumination" may accurately describe how creation feels to the artist, it cannot tell the whole narrative. Flashes of insight alone cannot constitute intuition [5], [6].

Insight Magic lies in that manner

Theology or possibly magic. We no longer subscribe to Descartes' position from the seventeenth century, according to which all human judgement is basically unrestricted and that it is in this regard that we are genuinely created in the image of God. Similar skepticism should be used to twentieth-century "explanations" that rely on an unstudied power of intuition or, as in Chapter 1, heavenly inspiration from the creative elite. Mozart was "only a guest on this earth," according to Einstein, and we may relate to the concert program's statement that "Others may reach heaven with their works." But Mozart, he arrives from that place! While praising Mozart in such words, however, we should not take them literally.

Neither do insights originate from gods nor do they appear out of thin air. To explain flashes of insight, previous mental processes are required. The non-paradoxical definition of creativity provided in Chapter 3 will remove any air of mystery around the question of whether originality is really possible if it is based on earlier ideas. The in question thought-processes include some conscious ones. For many days, Archimedes, Kekulé, Hadamard, and Poincaré deliberated about their issue. In regards to Coleridge, who didn't have a specific "problem" in mind when he wrote Kubla Khan, he later recounted that shortly before he passed out in his chair, he had been reading this passage [7], [8].

DISCUSSION

Cublai Can constructed a grand palace in Xamdu that spanned sixteen miles of level land and was surrounded by a wall, fertile meadows, delightful springs, lovely streams, and various game animals. In the centre of the palace was a lavish pleasure house that could be moved from one location to another. Additionally, Coleridge's notebooks reveal that he was an exceptionally attentive reader, consciously discriminating every phrase (compare this passage to these four lines from the poem: "In Xanadu did Kubla Khan/A stately pleasure-dome decree/So twice five miles of fertile ground/With walls and towers were girdled round".

Even the reports of individuals (like Coleridge) who have a keen interest in the functioning of the creative imagination cannot be accepted at its value. For instance, we will learn in Chapter 10 that Coleridge presented conflicting accounts of his time spent at Kubla Khan and that some of his accounts are flatly refuted by documented evidence. We'll also learn how a more systematic approach to introspection might reveal fleeting mental contents that are often forgotten. The many introspective accounts of bath, bed, and bus, however, strongly incline to the conclusion that creativity cannot be fully described by conscious processes. Both scientists and artists have contended that crucial brain processes must also be occurring subconsciously.

For example, Coleridge believed that the unconscious was essential to the development of poetry. He talked of the "hooks and eyes" of memory and was interested by how the mind can recall a wide variety of startlingly pertinent thoughts. In fact, he took the pains to write down the text he had been reading just before having his exotic dream of Xanadu because he was so fascinated in the unconscious association abilities of memory. He also believed that associative memory, is crucial to both literary and scientific originality. A mash up of unconsciously held beliefs. He identified four stages of creativity preparation, incubation, illumination, and verification with variable amounts of conscious and unconscious mental labour. Hadamard subsequently called these stages similarly. The planning phase involves deliberate efforts to address the issue by using or overtly modifying tried-and-true techniques. The experience is frustrating since it seems to be fruitless despite its apparent success [9], [10].

Successful inventions are first created during the second phase, which might span for minutes or months. The conscious mind is preoccupied with other issues, other tasks, and maybe even a sightseeing excursion. However, Poincaré claimed that below the level of awareness, thoughts are continuously merged with a freedom that is not allowed for awake, logical cognition. (He maintained that incubation entails active mental labour, not just a restful respite; it provides some evidence in his favour. Then comes the moment of insight, to which Poincaré credited a significant mental history despite the fact that it was an unanticipated conscious experience: "sudden illumination is a manifest sign of long, unconscious prior work." After the new conceptual ideas are listed and put to the test, purposeful problem-solving resumes. Hadamard used the word "verification" to describe assessment in the arts, but it is more appropriate to use the more generic term "evaluation" in science and mathematics.

This four-part examination is not a sentimental ode to the utmost grandeur of the unconscious. On the contrary the subconscious self is not in any way inferior to the conscious self; it is not completely automatic; it is capable of judgement; it has tact and sensitivity; it knows how to pick and to divine. This is a first hypothesis. Do I say anything? Since it succeeds where the conscious self has failed, it is more adept at divination than the conscious self. Isn't the subconscious self, to put it simply, better than the conscious self? I admit that I would find it difficult to accept it. Poincaré stressed that "unconscious work is possible, and of a certainty it is only fruitful, if it is on the one hand preceded and on the other hand followed by a period of conscious work," far from minimising the significance of awareness.

Poincare's theory is particularly appropriate for mathematical and scientific innovation, since it is typical to clearly identify and study a particular challenge during preparation and utilise it as a test during verification. This is not always the case when it comes to creative innovation since the creator may not have a certain objective in mind; for instance, take a look at Kubla Khan's writing. Even yet, it's common for artists to have a project or at least a previous "problem." Coleridge so said multiple times that he intended to write a poem about an ancient mariner, and Bach created a collection of fugues and preludes that methodically explore certain harmonic possibilities. Additionally, artists like painters, musicians, and poets often spend a lot of time reviewing their creations. However, this does not prove that Picasso did not utilise assessment (how did he know he had discovered it when he found it?. They do, on occasion, indicate that no such reflection is involved. For instance, consider Picasso's "Je ne cherche pas, je trouve." It simply demonstrates that, in certain instances, he believed the innovative structure didn't need to be modified.

This kind of "complete" lighting is fairly uncommon. Art historians sometimes unearth the artist's discarded initial ideas, concealed behind the apparent layers of paint, by using more advanced scientific procedures, much as composers frequently make modifications to their original scores. When painting a mural before the plaster sets, for example, adjustments may need to be kept to a minimum. When a jazz guitarist improvises a song to fit a certain chord progression, though, corrections may be difficult. However, the artist assesses the work in order to improve upon it in the future. In essence, Poincare's four-phase approach enables the arts and sciences to innovate in largely similar ways. But how, specifically? What does the unconscious do, and why does awareness need to come before and after it? Poincare's response was that planning stimulates potentially pertinent unconscious concepts that are already merged. A select number are wisely chosen (according to their "aesthetic" traits), and they are then carefully refined. He struggled to think of a way that these things might happen, so he proposed.

Consider the future components of our combinations as being similar to Epicurus' hooked atoms. These atoms are immobile and, in a sense, fastened to the wall during total mental relaxation. On the other hand, some of them are separated from the wall and set in motion during a time of apparent rest and unconscious labour. They seem to be flashing in all directions. Gnats in a swarm, or, for a more sophisticated example, gas molecules from the kinetic theory of gases. Then, the effects of each other might result in novel combinations. What purpose does the first conscious work serve? Evidently, it is to unhook some of these atoms and mobilise some of them. After this shaking up, take them off the wall and place them in a swing. These atoms do not go back to their original rest because we have placed our will on them. They dance uninhibitedly on. Now, our will didn't choose them at random;

instead, it worked towards a purpose that was clearly defined. The atoms that have been mobilised are those from which we can predict the desired outcome, not any atoms at all.

The most productive combinations among those picked are often those made up of constituents collected from distant areas. ...The majority of these pairings would be completely infertile, but some of them, which are very uncommon, are the most prolific of all. The metaphor Poincaré used to describe the process of creation is not without merit. But it conflicts with instances like Hadamard's, who claimed to have discovered a method that was "quite different" from any he had previously explored. How might anything like this occur if the gnat-like thoughts, first triggered by conscious effort, are only "those from which we might reasonably expect the desired solution"?

Furthermore, his vision is unable to explain why combining parts from many fields might sometimes result in combinations that are more creative as opposed to bizarre or nonsensical. Both of these issues are reminiscent of the conundrum from Chapter 1 and can only be answered if we have a better understanding of the distinction between creativity and simple novelty. Thirdly, Poincaré was not enough Epicurean. According to Epicurus, different material atoms have different shapes and hooks, making certain pairings more plausible than others. Poincaré, however, placed the hooks on the wall rather than the atoms, and (as he disregarded the forms of the atoms and hooks) made no allusion to the differential affinities between concepts, much less how normal affinities may be differential be successfully defeated. Finally, Poincare's stress on "the automatism of the subliminal self" creates a fourth issue with this depiction of the random interactions of undifferentiated atoms. You may find it weird that I refer to this as a "problem" considering that I said in Chapter 1 that concepts from the field of computers might shed light on creativity. What is an automaton if not a computer? Someone who favours a computational theory of creativity must, by definition, hold that both the subconscious self and the conscious self are automata.

Not necessary; there are two different definitions of "automatism." It can imply that the system in issue operates in accordance with comprehensible scientific principles that, together with its input history, decide what it accomplishes. When anything is described as automatistic in this sense, it is being said to be a principled, maybe entirely autonomous system (or mechanism). As an alternative, the phrase may be used (negatively) to deny that the system has qualities like judgement, discernment, and choice. These two senses are not mutually inclusive. Given that choice and judgement may be able to be explained scientifically, they could not even apply to the same category of objects. My assertion (that creativity may be computationally comprehended) was positive; Poincaré's was not. He disputed that the unconscious self "is capable of discernment; [that] it has tact, delicacy; [that] it knows how to choose, to divine," which is another way of saying that it is blind like a group of gas molecules.

In Poincare's opinion, incubation occurs automatically or blindly. Koestler criticised the practise as being indifferent. Despite acknowledging the significance of the unconscious, Koestler did not think the haphazard assembly of a variety of distinct gas molecules was a useful metaphor. He came to this conclusion after citing a wide range of fruitful historical examples: The marshy beach, the area between sleep and full waking, seems to be the most fruitful area [in the mind's inner landscape], where the matrices of regulated thinking are already active but have not yet sufficiently solidified to hinder the dreamy fluidity of imagination. He meant the organised conceptual frameworks that, in his opinion, support conscious thinking when he referred to "the matrices of disciplined thought." According to Koestler, creativity is the 'bisociation' of two conceptual matrices that are not typically associated and may even appear incompatible: 'The basic bisociative pattern of the creative synthesis [is] the sudden interlocking of two previously unrelated skills, or matrices of thought.'12 The more unusual the bisociation, the more room there is for truly creative ideas. Unconscious thought may take many different forms, such as visual imagery, tangible (and sometimes personal) examples of abstract concepts, changing attention, backward reasoning, and creation of various parallels. Additionally, he highlighted the value of extensive training and experience, whether in science or the arts. So, Koestler and Poincaré both defined creativity as the unintentional fusion of concepts from several fields. However, only Koestler brought up mental structure. According to him, creativity makes use of certain conceptual matrices and is in some way subconsciously influenced by them.

Koestler deemed Poincaré's explanation to be "mechanistic" because of this. Nothing directs one gnat to fly in the direction of another, nothing brings one gas molecule closer to another, and nothing keeps their haphazard dance from degenerating into chaos. More than just thoughts automatically blending together is needed for creativity. It is insufficient to just bisociate matrices arbitrarily. Both the genius and the crank exhibit [the] struggle against limitations, which are required to preserve the order and discipline of conventional thinking but a barrier to the creative leap; what sets them apart is the intuitive direction that only the former experiences. Koestler saw the necessity for a thorough explanation of how this intuitive guidance works, of which (as he was well aware) he could provide only the bare minimum. For instance, after discussing numerous scientific discoveries, he said: Some authors believe that the discovery of hidden parallels encompasses the whole creative process, but where does the hidden. How is a resemblance hidden, and where? was not "hidden" anyplace; it was "created" by the mind. "Similarity" is not a thing offered on a plate [but] a relationship developed in the mind via a process of selective focus.

Science, writing, and the arts.

Poincare believed that creativity was based on universally recognized mental traits. Even Coleridge saw the emergence of creative ideas as a component of human memory in general, notwithstanding his romantic emphasis on the directing function of the poetic imagination. According to recent psychological studies, creativity is a component of intelligence in general, which in turn encompasses a wide range of abilities. For instance, according to educational psychologist David Perkins, creativity is rooted in psychological abilities that are shared by all people, such as perception, memory, the ability to notice interesting details and recognize analogies. He also demonstrates that more conscious activity occurs than is typically acknowledged. The difference between someone who is very creative and someone who isn't isn't any unique ability, but rather more knowledge (in the form of honed skill) and the will to learn and apply it. This drive persists for a very long time, perhaps influencing and inspiring a lifetime. Howard Gruber has shown, for instance, how Darwin established a guiding principle over the course of several years [11], [12].

Michael Polanyi, a philosopher and scientist, also emphasized the importance of expertise, arguing that all abilities and intuitive insights are rooted in "tacit knowledge." Up to a point, tacit knowledge can be made explicit (in instructing students or apprentices, or in theorizing about science or art), and doing so 'immensely expands the powers of the mind, by creating a machinery of precise thought'16. However, some normalized knowledge always remains, and the new insights arising from it cannot be immediately captured by conscious thought. According to the mathematician Carl Gauss, "I have my solutions, but I do not yet know how I am to get there."

CONCLUSION

The neurological system engages in processes of abstraction and generalization that are mainly unknown, such as seeing similarities between two letters 'a' written by different hands. The true accomplishment 'Seeing an analogy when no one else saw one,'13 according to coveries. How much more difficult it is to recognise a new parallel if he couldn't even explain how we can recognise the basic alphabetic letters. The thought-processes Koestler described do occur, and they do appear to have a certain consistency, so what he stated about creativity was generally convincing and often illuminating engage in creative endeavours. But he didn't completely explain how creativity is possible since he didn't describe how these things occur. One of Koestler's approaches advantages was that it didn't rely on any elite-only creative faculties. On the other hand, he emphasised the significance of bisociation in daily humour and in both the layperson's and the expert's invention of novel ideas.

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CHAPTER 3

THINKING THE IMPOSSIBLE

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ABSTRACT:

This paradox is based on the idea that creation ex nihilo is required for true originality. If it is, uniqueness cannot happen until something remarkable happens. Anyone unable to describe it in miraculous terms (such as divine inspiration) must come up with another definition since it does happen. It would be best if they could also explain why the ex nihilo idea is so alluring. We cannot discriminate between creative and uncreative thoughts without a consistent definition of creativity. And if we are unable to accomplish this, we have no chance of learning how creative ideas are generated. The goal of this chapter is to define what constitutes a creative idea. We'll examine how computational concepts may improve our comprehension of creativity. The works of the mind must be generated by the mind's own resources in the absence of magic or supernatural inspiration.

KEYWORDS:

Components, Impossible, Thinking, Mixture.

INTRODUCTION

Given that she believed unicorns to be fantastical beasts, Alice was shocked to see one in the realm beyond the looking glass. She immediately consented to believe in it nevertheless after having met it. Similar to how we believe in creativity, we do so because we see it in action. However, creativity might seem completely unattainable in the abstract, even less likely than unicorns. Therefore, those wishing to debunk creativity often claim that it entails some new.

A Mixture of Already-Existing Components

Poincaré concurred, as we have seen, with Hadamard's statement that "it is obvious that invention or dis- covery, be it in mathematics or anywhere else, takes place by combining ideas"1. Koestler confused the definition of creativity—the bisociation of ordinarily unrelated matrices—with the explanation of how it occurs. Combination theories often define creative ideas as including odd or unexpected pairings. Many contemporary psychologists make the assumption (when explaining their research) that the more outlandish ideas are the more creative ones and use the phrase "statistically surprising" to define creativity. There is nothing wrong with this as a description of one sort of creativity. All innovative ideas are out of the ordinary and startling, not the least to those who came up with them. Ah, what a silly bird I have been! They may eventually appear glaringly clear, but they often make themselves known with a startling surprise. Some are also more unexpected than others. Surely the 'more innovative' ideas are the ones that are more out of the ordinary? This definition has a flaw that is simple to fix. The idea of creativity is loaded with values. A creative thought must in some way be helpful, enlightening, or challenging. However, a strange amalgamation of concepts is often completely useless or boring [1], [2].

Therefore, combination theories strictly speaking should explain the criteria of value (to be discussed in subsequent chapters), not only have it known implicitly. Combination theories have a severe flaw in that they are unable to adequately explain or define the fundamental uniqueness that distinguishes the most perplexing examples of creative thinking. This is what first supports the ex nihilo viewpoint and makes creation appear so enigmatic. Unexpected thoughts are really surprising. The kind of surprise, or even shock, that is involved, though, is what matters most. When one is astonished, it means that some of their preconceived notions did not come true. According to combination theories, statistical expectations are what matter. If so, our amazement at discovering an original concept must be reduced to just marvelling at the unlikely, like when a rank underdog wins a steeple race [3], [4].

Consider Manley Hopkins' description of thrushes' eggs as "little low heavens" or Coleridge's depiction of water snakes as emitting "elfish" light as two instances of poetic imagery that fit the combination-theory approach. Remember the comparison Kekulé made between "long rows," "snakes," and molecules? Scientific breakthroughs also often entail the strange juxtaposition of notions. Although it does not explain how the combination occurs, the combination-theory does have some merit. It does, therefore, define a certain kind of creativity. However, it can't tell the complete tale. It takes more than just being out of the ordinary for an idea to be really innovative not even if it is priceless as well. It also doesn't enough to be just new or something that has never occurred before. Ideas that are fundamentally innovative are profoundly startling [5], [6].

When it comes to this kind of innovation, our expectations should be based on possibilities rather than probabilities. In these situations, our astonishment at the original thinking serves as a reminder that things haven't turned out the way we expected, nor even the way we imagined they could. It is not captured by phrases like "unusual combination" or "statistical surprise." Furthermore, they provide no explanation for how the peculiar combination may occur. (How could someone compare a serpent to a molecule or a thrush's egg to a little low heaven?) Creation-as-combination conflates routine novelty or simple abnormality with radical uniqueness. It does not distinguish between a concept that has never been thought of before and one that, in a pertinent sense, could not have been thought of before. Clarification of this particular notion is required, which should be accomplished by providing a broad description of creativity. The EX NIHILo perspective on creativity makes the solution simple, which is why it might be alluring. There was nothing there to generate the basic, apparently unattainable innovation before the miraculous moment, thus it could not have happened. For example, the Times writer quoted in Chapter 1 said that the creative source was a heavenly spark, without whose influence even Mozart's intellect could not have been able to create.

Earned Honor

The solution is trickier from a strictly naturalistic perspective. What can it possible imply to state that a thought "could not" have happened earlier if all of the mind's concepts come from within? Undoubtedly, the creator has to have some ideas as "raw material" as well as the necessary expertise to identify and shape them. For instance, Coleridge would not have been able to write Kubla Khan without reading the passage from Chapter 2 since the imagery is essential to the poem. Without finding the soiled agar plate on the window ledge and without his extensive background in bacteriology, Alexander Fleming may not have discovered penicillin. However, this doesn't always happen; sometimes there isn't even a random incident that sparks fresh ideas. For example, Kekulé and Kepler spent a lot of time pondering their issues before coming up with answers. Someone would argue that in these situations, when the necessary mental resources were long before the thought surfaced, it should have come sooner.

How might Kekulé's discovery of the benzene ring be considered a unique occurrence that 'could not' have occurred before? We have shown that Copernicus' theory of elliptical orbits predates Kepler's theory of elliptical orbits, and that both men had thought of it before Kepler did. How is it possible to claim that it "could not" have happened earlier? Are we really discussing dates (moments in time), or are we referring to something subtler? If so, what? We must take notice of two distinct definitions of "creative" before we can directly respond to these questions. Both are often mentioned in discussions and publications about creativity, and they are sometimes used interchangeably (despite the context frequently favouring one over the other). I refer to one sense as psychological (short for P-creative), and the other as historical (short for H-creative). Both are originally defined in relation to notions or modes of thought. However, they are then used to define related meanings of "creative" (and 'creativity,') that apply to persons.

DISCUSSION

The psychological sense refers to concepts that, to the mind that came up with them, are unexpected or possibly even fundamentally innovative (whether in science, needlework, music, art, literature, etc.). Regardless of how many other people may have had the same concept previously, Mary Smith's thought is P-creative if she mixes ideas in a manner she has never done before or if she has an idea that she could not have had before. Ideas that are new in relation to all of human history are considered novel in the historical sense. Only if no one else has ever thought of it before is Mary Smith's novel concept H-creative. Either an H-creative 'combination' or an H-creative 'impossibility' may exist. Any kind of creativity, however, is only considered historically original if it has never been conceived of before. People may also be considered creative in two different ways. A P-creative person has a (more or less maintained) ability to come up with P-creative concepts. A person who has generated one or more H-creative ideas is said to be H-creative. Once again, this is true of both combinational and impossibleist creation [7], [8].

P-creativity is more crucial for our goals even if H-creativity is the more glamorous idea and what most people think of when they talk about "real" creativity. An alternate definition of P-creativity takes into account the fact that we may be hesitant to attribute the label of "creator" to someone who only thinks of an idea without understanding its importance. Kepler was first astonished and dissatisfied with the idea of elliptical orbits, referring to it as "a cartload of dung." Later, he realised it was importance. He ‘really' found elliptical orbits only after he was inspired by his notion and had proven it, according to Hadamard's understanding of creativity. In a similar vein, one may opt to define a P-creative concept as a basic innovation (in comparison to the person's prior ideas) whose significance is understood by the individual.

Each definition is tenable, and each may be vehemently advocated in contentious discussions on creativity. Which one we choose doesn't really matter all that much. Since it commonly occurs that both are satisfied by the same situation, there is frequently no need to choose between them at all. The psychological distinctions that are involved must be noted so that we may keep them in mind while we explore the diverse variety of real-world instances. In other words, we must allow for both definitions of P-creativity in addition to differentiating between combinational and impossibilist creativity.

On both definitions, Kepler's concept of elliptical orbits qualifies as "P-creative" (either when he first had it or when he first appreciated it). However, only according to the second definition does his concept qualify as "H-creative" (in which case, Copernicus cannot be considered creative in relation to elliptical orbits since he never acknowledged them). On either definition, Kekulé's notion of the benzene ring was, in contrast, both P-creative and H-creative.

In our opinion, KEKuL's concept was H-creative. Continuously, lost texts are discovered, and Sotheby's has numerous stories to share about valuable artworks discovered in people's attics. There have probably been many brilliant works of science and art destroyed. For many years, Gregor Mendel's groundbreaking discoveries on heredity were kept secret in an unreadable botanical journal and an Austrian monastery's unread archives. Therefore, it's possible that Kekulé wasn't the first to consider the benzene ring. Of course, nineteenth-century chemists were well aware of the benefits of establishing one's scientific priority, which today can involve dishonest competition for Nobel prizes and global patent rights (we saw in Chapter 2, after all, that Kekulé's P-novel idea about "chains" of carbon atoms had been P-created by Couper). It is thus quite doubtful that any of his contemporaries had predicted Kekulé without making it known loud and clear, with the possible exception of a Trappist monk devoid of all self-regard and worldly desire [9], [10].

The importance of motivation in H-creativity will be discussed in Chapter 10, but monk would have needed a motivational commitment to the creative quest: if not for self-glorification, then for the glory of God.) It is even less likely, for reasons discussed later, that Kekulé's idea had originated in some previous century. Kekulé's first priority is almost guaranteed. However, in practise, ideas may only be classified as H-creative provisionally, based on the historical data already available. There can be no psychological justification for H-creativity as such since it is a historical category (many of whose examples are unknown). There cannot even be a logical explanation for it.

An idea's birth, long-term viability, and how highly and widely it is regarded at any particular moment rely on a variety of different factors. Particularly significant are shared information and changing intellectual trends, which also contribute to the many instances of "simultaneous discovery" that have been documented. But other elements—loyalty and resentment, money and health, politics and religion, communication and information storage, commerce and technology—are also important. Consider the burning of Alexander the Great's library as an example of how storm, fire, and flood may also contribute. Iconoclasts often make use of these historical and social contexts to undermine or at the very least degrade the reputations of H-creativity. For instance, a literary critic recently said that Thomas Middleton, one of Shakespeare's contemporaries, was a greater writer than Shakespeare.

Shakespeare wrote the majority of his plays for a single theatrical company, but Middleton wrote for several companies, the author notes. The Globe had a financial motivation to publish a folio of Shakespeare's plays, but nobody had a similar financial reason to publish a collection of Middleton's writing. Shakespeare's plays were thus more widely read at the time than Middleton's and more likely to be kept in libraries for future generations. He points out that the licensing-act of 1737 caused a decline in the number of new theatrical performances, making it very difficult for any of the long-dead Bard's contemporaries in the eighteenth century to get their plays performed in place of his. Additionally, he asserts that those in positions of authority have fostered Shakespeare's "cult" over the years in order to further a variety of political and economic goals, including promoting monarchy, quelling uprisings, nationalism and imperialism, tourism, and academic careers.

These kinds of cultural influences have helped to sustain and expand the fame of Shake-Spears. There is unquestionably a Shakespeare business, but not a Shakespeare cult. It does not follow that there are no notable differences between the literary innovation of Middleton's and Shakespeare's works in terms of their intrinsic value. That has to be defended on its own. (On this issue, the relativist critic should not assert too much: since there are no literary standards that are independent of cultural trends, one cannot state that Shakespeare was'really no better' than Middleton, just that he was not different.) Shakespeare's reputation for H-creativity is among several that, to some part, are dependent on cultural variables that have nothing to do with the inherent value of the work. This is something that even someone who is persuaded of Shakespeare's greatest genius must concede.

Science-related histories, for instance, often feature 'heroic' tales in which the heroes are selected in part for factors other than their actual accomplishments. The invention of radio, flight, or television is ascribed to a number of individuals of many nationalities by their fellow citizens. Certain persons may be classified as H-creative even within a single nation, partly because others want to bask in their reflected brilliance. The majority of the time, thorough historical study reveals that many of their contemporaries had thoughts that were comparable to their own, many of which even advanced knowledge. Many "heroes" of the arts may be described in the same way. In other words, the widespread admiration of so-called "H-creative" people significantly underestimates how much discovery is a communal process. This leads to the conclusion that no one, purely psychological criteria could identify what are considered to be the H-creative thoughts. But this is irrelevant since P-creativity is our major focus as we try to grasp how uniqueness is possible.

Additionally, P-inventiveness is crucial for evaluating the creativity of particular people, their capacity to come up with novel ideas. A power that can be more or less maintained is called an ability. To put it another way, creativity is a trait that tends to persist longer than intellect. Of course, when we inquire about someone's creativity at a certain period, we may be specifically referring to H-creativity. When he first came up with the idea of elliptical orbits, was Kepler "really" creative? Was Shakespeare "really" innovative when he came up with the Romeo and Juliet narrative, which was based on a Bandello tale, or when he plagiarised Plutarch's Lives to create Julius Caesar? In these situations, we act like historians, keeping historical standards in mind. However, creativity is evaluated as a personal trait (for the majority of the principally in terms of P-creativity (i.e., during the person's existence, if not in obituaries). If you have any doubts, think of the Turing Fellowship event.

Turing, who is widely recognised as the founder of computer technology and the man who cracked the German Enigma code during World War II, applied for a fellowship in mathematics at King's College, Cambridge, in 1934 when he was only a young man. He turned in a dissertation that proved a more precise version of a well-known statistics mathematics theorem. Referees who reviewed the dissertation noted that a renowned Scandinavian mathematician had just released an article including precisely this refinement. It was not published until around the time Turing submitted his dissertation, therefore there was no chance that he was aware of this work while he was writing his.

Turing was graciously given the Fellowship by King's since the reviewers were so struck by his paper's originality and brilliance. The current Fellows actually saw it as a plus for Turing because a renowned mathematician had likewise deemed the conclusion to be significant. Were they mistaken? Should they have rejected Turing's fellowship, saying, "Sorry, young man, but you aren't creative after all," since they saw H-creativity as being of utmost importance? Or maybe they ought to have grumblingly said, "Well, you can have your Fellowship. You're certainly not as imaginative as that other guy, however. It's unfortunate he didn't apply. That is absurd! An award for H-creativity is not given when a Fellowship is offered. Instead, it is a wager on the Fellow's potential to consistently come up with P-creative ideas, with the hope that some of them will also be H-creative. In conclusion, the committee made a logical choice.

To be sure, it does not matter that the Scandinavian study's findings were only recently released. Most mathematicians were still surprised by it, and Turing was not to blame for not having discovered it. But when assessing someone's creative potential, a century-long chasm might occasionally be overlooked. For instance, there is a beautiful geometrical demonstration of the equality of the base angles in an isosceles triangle. The proof by Euclid was fundamentally different and less straightforward. According to what is known, the beautiful proof was first found by the Alexandrian mathematician Pappus six centuries after Euclid, only to be lost throughout the Dark Ages and eventually rediscovered. A student of geometry at school who came up with Pappus' argument on the spot would be considered mathematically inventive, and with good reason.

Here it is once more—that enigmatic "could not." What else may that mean? We cannot understand non-combinational instances of P-creativity (or H-creativity either) unless we are aware of this cannot differentiate between radical surprises and just "first-time" novelties. What would constitute an innovation that was obviously possible to occur before? Think about the following phrase: sousewife con-naturality harlequin conspiracy priest. You probably see it as a dis-organised collection of parts with no internal coherence or organization. That's exactly what it is, too. I just came up with it by randomly opening my dictionary a number of times and scribbling with my pencil while keeping my eyes closed. But because I learned how to play such randomising games as a youngster, I might have created it long ago. Additionally, James Joyce may have done something with it, but most people could not understand the nonsensical non-sense. Random processes often don't yield extreme surprises, simply first-time curiosities.

What about the new claim that there are 33 blind, purple-spotted, enormous hedgehogs residing in the Tower of London, which was stated (undoubtedly for the first time in human history) in Chapter 1? This statement is at least comprehensible. However, by just using other English words, you might describe a great deal more interesting things, like five sympathetic long-furred dwarf tigers lazing outside the Ritz. and on forever more. If you were to write out an abstract schema for a certain grammatical structure using the concepts of grammar, you might use it to create an infinite number of phrases, some of which you may have never heard before. A few examples of six-word phrases covered by the schema include "The cat sat on the mat," "A pig flew over the moon," "An antelope eats with a spoon," and many more.

A theoretical linguist would be able to describe sentences of far more complexity using grammatical rules, and they may do it in a way that makes them easy to code. (A 1972 programme could parse sentences like "The cat sat on the mat" and "How many eggs would you have used in the cake if you hadn't learned your mother's recipe was wrong.") A linguist might even specify (and a computer scientist might programme) a list of abstract rules capable, in theory, of generating any grammatical English sentence, including all those that have not yet been spoken and never will be. Noam Chomsky, a linguist, observed that language users may continually come up with innovative ideas and dubbed language "creative" as a result. He was right to emphasise the endless fertility of language, and it is very pertinent to our current concerns. However, the adjective "creative" seemed debatable. It conveyed the idea that when individuals experiment with the possibilities offered by English grammar, new phrases are created. However, it made no mention of deviating from those grammar norms.

Despite the fact that the words concerning enormous hedgehogs and dwarf tigers are novel, it is obvious that both might have happened previously since they can both be produced using the same principles as other English statements. These phrases may have been created long ago by both of us, as proficient English speakers, as well as by a machine given access to English vocabulary and grammatical norms. The computational "coulds" in the preceding section are all capitalised. To put it another way, they relate to the collection of structures (in this example, The same set of generative rules (in this example, English grammar) are used to describe and/or construct all English sentences. The 'and/or' is required because a word-string that can be described by grammar rules may or may not have been created by making reference to those rules. In essence, there are two types of computational "coulds": timeless and temporal. In order to analyse creativity, its methods, and its essence, must sometimes differentiate between them. One concentrates on the structural options offered by "generative rules," which are seen as abstract descriptions. The other focuses on the potential that comes with 'generative rules' when they are seen as computational processes.

Consider these seven numbers as a sequence that a friend or computer really wrote down, rather than as a timeless mathematical structure. How did they get made? Using the first rule stated above, your buddy (or computer) may have really come up with these numbers: take the first number and square it; add one to the first number and square that; add two to the first number and square that; and so on. Maybe they (or it) followed the second rule, which goes like this: add the first number, take it again and add the next odd number, take the outcome and add the following odd number, and so on, adding consecutive odd numbers. In terms of computing procedures, there is undoubtedly a world of difference, particularly for someone who is more skilled (or for a machine that is more effective) at addition than multiplication. (A person who just memorised this list of seven squares would not have been creating anything and could not later generate any squares they had never considered before.)

A mathematical formula is comparable to the English language's grammar, the sonnet rhyming scheme, or a computer programme (which is seen as an abstract logical specification). One particular collection of structures may be (timelessly) described by each of these. Additionally, each may be employed at some point in producing those structures, some of which may not have been created previously. Sometimes, we want to discover whether an abstract set of rules or a certain schema might theoretically describe a certain organisation. - Is the number 49 a square? 3,591,471 – is it a prime? This is a sonnet; that is a sonata, right? Is it a piece of Impressionist art? Could Euclid's techniques be used to establish that geometric theorem? Is that string of words a sentence? Are rings molecules that may be described by the early 1860s chemistry (after Kekulé's historic bus journey, but before his fireside "dream" of 1865)? This kind of query, as opposed to asking how an idea came to be, is asking whether or not it is innovative. But anytime a certain structure is created in reality, we may also inquire as to what computational operations took place in the system in question. Did your buddy add or square subsequent odd numbers in a certain order? Did the computer use a formula that might produce squares infinity? Was the sonata written by following a sonata-form manual? Was the theorem established using Pappus' or Euclid's methods? If not, how did Kekulé come up with the notion of the benzene-ring? Did he base it on the well-known chemical principles? This kind of query is what it means to inquire as to how an idea—creative or otherwise—actually came to be [11], [12].

CONCLUSION

The fact that just one person predicted Turing is also not noteworthy. As we have seen, creativity is sometimes defined in terms of the uncommon, and H-creative ideas—on which King's was betting—are by their very nature, exceedingly exceptional. Experience has shown us that someone who has come up with one extremely original concept is likely to come up with several. The committee was thus justified in its choice, Scandinavians included (Turing himself made key contributions to computational logic, theoretical embryology, and cryptology). But generally, a P-creative concept doesn't have to be out of the ordinary. For the individual who is producing it, it is unique, but it may not be for others. Even while we may be able to foresee that the individual in question would come up with that P-creative concept soon, the fact that we can forecast it does not lessen its creative value. Indeed, every human newborn is creative, as we will show (in the next chapter). Because children's brains grow not only via the acquisition of new facts and their fun mash-ups in inventive ways, but also through the development of previously unimaginable concepts.

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CHAPTER 4

AN OVERVIEW ON THE MAPS OF THE MIND

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ABSTRACT:

The necklace-building guideline is as follows she may add a blue bead to both the second and third group of blue beads if she already has a necklace made up of blue beads, a red bead, blue beads, a white bead, and then more blue beads. You inform her that the word "some" denotes "one or more. Together, you spend some time practicing, growing your library of employing this principle, necklaces. You then inform her about the restriction on the types of necklaces that may be worn as she is preparing to put a freshly created necklace around the neck of her teddy bear. Only necklaces with a particular number of blue beads, one red bead, one blue bead, one white bead, the same number of blue beads, and a final blue bead are permitted for use on stuffed animals and dolls. To put it another way, the practical ready-made necklaces that can be used to ornament the toys have the form. Together, you and her could discover something intriguing if you play this game for the remainder of the day.

KEYWORDS:

Atoms, Beads Maps, Mind, Necklace.

INTRODUCTION

Imagine a youngster pleading for your attention on a rainy Sunday afternoon. She is tired with Snakes and Ladders yet is still a beginner at chess. She has a variety of dolls and stuffed animals. She is also quite conceited. You need a game you can play with her to occupy her for a bit (so is her brother, but he is sick upstairs). Let's try this. Making bead necklaces for her, the dolls, and teddy bears to wear is the goal of the game. You present her with a box of blue beads, some fine thread, and a bag full of ready-made necklaces consisting of red, white, and blue beads that you had the foresight to prepare. She joyfully lands on the material, but you remind her that she cannot act anyway she pleases. Two rules govern the game: one governs how to create new necklaces, and the other governs which necklaces the teddies and dolls may wear. You first instruct her on how to create additional necklaces. She is required to utilise an existing necklace as a "guide" each time she threads a new one (or one she has previously created while playing the game). She is only allowed to add two blue beads, neither more nor fewer, to the guide-necklace, and she must do it in a certain manner. Additionally, only certain types of necklaces may be used as guides [1], [2].

I'll give you a chance to play the game on your own before I explain what it is. Indeed, for reasons that will soon become evident, I highly advise you to do this. You don't need any actual beads or thread (although you may find this first fooling about particularly beneficial if you don't consider yourself to be mathematically oriented). Instead, you may use pencil and paper to depict the aforementioned bead-sequences, like I did. Then, take a moment to experiment with the two rules before moving on to the next step. Check to see if anything sticks out to you about the nature of the game (and write your thoughts down). Keep track of the "playing around" you engage in throughout the process as well. What inquiries do you make of yourself? Are you pleased with this game or do you attempt to think of any slightly different ones? In the afternoon on Sunday, ET's "ET BAcK." No matter how lengthy a doll-wearable necklace is, as you (and the kid) could observe, on both sides of the white bead, there are an equal amount of blue beads overall. She now declares that each of her toys and animals has a unique "lucky number" after realizing this. She informs you solemnly that each one desires a customised necklace with their fortunate colour of blue beads to the left and right of the white bead. If it proves to be difficult to produce a necklace for 9, 14, or 17, you sigh: you envision tantrums. But when you realise that one of the ready-made necklaces you produced earlier has the following shape, you may relax. After experimenting with it for a short while, you realise that you can create a doll-wearable necklace that is suited for any doll if you have enough beads and patience. You can build a necklace with precisely that many blue beads on each side of the white no matter what fortunate number the youngster imperiously demands. Even the green hippopotamus is eligible for a custom jewellery [3], [4].

Maybe you think poorly of dolls and despise decoration on people. You like learning games instead? - Excellent. If the youngster hasn't already realised it for herself, you point out that this simple game offers a method for doing addition. The sum of the beads in the first blue group and the second blue group, given any doll-wearable necklace, equals the beads in the third blue group. She can now swap '+' for 'r' and '=' for 'w' if she has been writing descriptions of necklaces down with a pencil and paper, as we have been doing. The mathematical calculation will now be valid if the description refers to a necklace that the dolls are permitted to wear. '1 + 8 = 9' or '33 + 66 = 99', for example. If you're really ambitious and she isn't too worn out, you could show her how number theory and the game have some abstract similarities.

Every doll-wearable necklace, for instance, symbolises a true number theory theorem if it is seen as an addition. The most practical pre-made necklace, is equivalent to the most basic addition axiom: "1 + 1 = 2." By continually adding one to each smaller integer, any integer (and hence any fortunate number) may be created. Working her way up to "1 + 8 = 9," she may be confident that she will be able to create a necklace with nine blue beads on each side of the white one. Additionally, the length of doll-wearable necklaces is a number-series that is theoretically infinite. For example, it will be time for dinner, there won't be any more beads, or there won't be any thread. However, because there is no "stop-rule" dictating that you must stop constructing if you have a necklace of a certain kind, you might continue building indefinitely. (When she mentioned the "lo-o-o-ng necklace," she could have had a sight of this for herself.) You've probably been watching a youngster play happily for a while, so you're probably in a good mood. This is fortunate. Because the child's interest is now completely piqued, you could have some grey hair as a result. he necklace-ame is based on a formal system (the "pq-system") defined in Douglas Hofstadter's intriguing book Gödel, Escher, Bach.1 Hofstadter utilises the pq-system to demonstrate a variety of abstract questions about the nature of generative systems, computing, and representation. Its capacity to provide a sense of what it is like to engage in creative mathematics—indeed, what it is like to engage in creativity in various contexts—is of great importance to us [5], [6].

DISCUSSION

I don't mean adding 837,921 to 736,017 to obtain 1,573,938 (let's suppose no one has ever added that amount before). Instead, I'm talking about creating new generative systems and mathematical approaches. Even the most pious person may like science fiction. We all push the boundaries and think about breaking them. We increase the restrictions (lucky numbers?) and observe the results. We look for the imposed restrictions (only two numbers to add) and attempt to get around them by altering the rules. We act on intuition (let's perform subtraction as well), and sometimes we may find a way out of a dead end. Some individuals even make a profession by testing the boundaries of the law and uncovering all the computational "cans" that exist. Ingenious tax attorneys refer to these openings as loopholes, which ingenious tax lawmakers then shut [7], [8]. To sum up, there is nothing more natural than "playing around" to determine the possibilities and boundaries of a certain style of thinking. This is often accomplished by contrasting two different ways of thinking and making the most accurate mapping possible. We may observe what types of outcomes the necklace-game can and cannot yield, for example, by comparing it to arithmetic. And nothing is more natural than attempting, successfully or not, to alter one's existing way of thinking in order to allow for previously impossible notions. In other words, nothing is more natural than the path from investigating a certain way of thinking to, at least partially, changing it. This involves modifying the current norms in order to establish a new conceptual space, not discarding any rules at all (that would be insane). Constraints on thinking enable specific concepts and mental structures rather than just restricting them. (The youngster would not have been able to add by necklace if you had indulgently permitted the dolls and teddy bears to wear just any string of beads.)

The beginning of non-competitive innovation is xLorATIon. Indeed, even merely studying a thinking pattern will result in numerous innovations if it is an intriguing one (we'll discuss some instances later) may legitimately be considered "creative." Sometimes, mental research has a clear objective, such as paying less tax, completing subtraction by necklace, or figuring out the structure of the benzene molecule. Frequently, it doesn't play and creativity have a lot in common, both in this and other ways. "Preparation" is defined as purposeful efforts to tackle the issue by the use of or explicit adaptation of tried-and-true techniques. Many situations fit this description, such as efforts to expand the necklace game to include subtraction. But what if the 'issue' doesn't exist? When it came to composing Kubla Khan, Coleridge's challenge was to get his ideas down on paper before he forgot them, which is not the same as the problem Poincaré had in mind. Similar to most games, creativity often has no set objectives and is open-ended.

Or, more accurately, its objective is exploration, with the mind serving as the field of investigation. Some explorers of the planet Earth are on the lookout for a particular place, such Eldorado or the Nile's source. However, a lot of people just want to know "what's there"—for example, how far does that plain go and what happens to this river when it gets there.Is this a desert island?What's on the other side of the mountain range? Similar to how a scientist or artist could investigate a certain way of thought to determine its potential and pinpoint its limitations. In addition to creating their own maps, explorers often bring pre-made maps with them when they set out on their journeys. Some even came out with the express purpose of producing maps, like when Captain Cook sailed across Australia to map its coastline. Maps instruct the traveller in a variety of ways rather than just providing solitary pieces of information (such as "Here be mermaids").

In contrast to Theseus, who had a ball of thread to guide him out of the Labyrinth, map-bearers seldom have to precisely retrace their steps while using a map to return to familiar locations. Map-bearers may also explore a limited area with the knowledge that something is there to be discovered: relocating camp three miles to the north is comparable to saying a new phrase or creating a new tune in a well-known musical genre. The map may even show how travellers might reach a region of the globe they have never been. Sometimes the map delivers terrible news: crossing an insurmountable mountain range is required to go from here to there. A list of landmarks is less helpful since, like parroting the first seven square numbers, it does not provide any new conceptions. In summary, the map is utilised to create an infinite number of highly valuable "coulds" and "cannots." The maps in question when it comes to non-combinatorial creativity are mental maps. These mental maps, which exist in the mind itself, are generative systems that direct thinking and activity in certain directions but not in others.

For instance, scientific theories outline a conceptual area that may be investigated. Another place, a different dot: "Another benzene derivative was analysed! “Follow the river and see where it leads. "So benzene is a ring! What about the additional molecules that can be present in living things? Identify the boundaries: "Are all living things born with the same genetic code, which causes DNA to generate proteins?' The source of the Nile, for example, and other hitherto unseen objects are made possible through theoretical maps. For instance, Mendeleyev's "periodic table" led nineteenth-century chemists to believe that some gaps in the table indicated the existence of unidentified elements. Theoretical maps are useful for determining "how to get there from here." Thus, a broad understanding of chemical structure provides specific routes for creating chemicals, even ones that have never been seen before. Additionally, scientists may record the degree to which two or more maps coincide where such maps already exist. The periodic chart was originally based on the elements' observable characteristics, but it was subsequently discovered that it corresponded to a classification based on atomic number.

There may be opposition to a new theoretical map because imagined environments might be difficult to comprehend. Three years before Mendeleyev championed the periodic table, a concept quite similar to it had been offered, and a well-known scientist had cynically questioned if the proposer had considered grouping the elements according to their first letters. Similar to scientists, artists map and remap their surroundings as they go. By depicting three-dimensional situations as patches of colour that match to the light reflected from the scene, Impressionist artists explored the possibilities and the boundaries of what was possible. For instance, the style of Claude Monet's paintings of the Giverny water lily pond and Japanese bridge became more and more severe.

Boredom and/or curiosity prompt a modification in the rules after they have been well tried and the generating potential of the style is fairly obvious. Georges Seurat and Paul Signac, two pointillistes who investigated the potential of a tightly constrained palette, reduced colour patches to simple dots. Painters who were schooled as Impressionists in the beginning—like Paul Gauguin—threw one style aside in favour of another, and so on. An equivalent investigation may be heard in Western music, where the scale's intrinsic possibilities are continuously defined, tested, and expanded. As we'll see, but it makes sense as a trip through this musical realm to go from Renaissance music to Schoenberg's more outré works. A mental map's structural elements may sometimes be consciously accessed. Chemists specifically look for theoretically similar chemicals to investigate. The forty-eight preludes and fugues composed by Bach were an organised investigation (and definition) of the potential and internal organisation of the well-tempered scale. The hues that the pointillistes chose to employ were purposeful choices. And when he called Ebenezer Scrooge "a squeezing, wrenching, grasping, scraping, clutching, old sinner," Charles Dickens purposefully took use of English syntax.

Dickens demonstrated that there are more things in grammatical space than were typically dreamed of in their philosophy. However, the map is often unavailable to consciousness or is only partially so. This is not very mysterious. The majority of our skills are mostly or entirely dependent on unconscious brain processes. Psychologists are not the only ones who use indirect, non-introspective methods to conceal mental maps. Theoretical linguists, musicologists, literary critics, and historians of science or art all work to map the many modes of thought used (consciously or not) in their respective fields. Therefore, in many respects, mental exploration is similar to outside discovery. But there is one significant distinction. In contrast to physical geography, mental geography is malleable.

Of course, both are impacted by unforeseen occurrences and long-term change: senility and continental drift, volcanic eruptions and serendipity. But only the mind has the power to alter itself. Only the mind is capable of selective, intelligent self-change. The 'journey through musical space', on which Bach, Brahms, Debussy, and Schoenberg all participated, was a voyage that not only investigated the appropriate space but also created it. Additionally, this invention was selectively limited, much as all other creations. (In fact, even though it was contentious at the time, looking back on it now, it seems almost inevitable.) In other words, only the mind has the power to convert computer "cannots" into computational "cans," turning the impossible into the conceivable.

The foundation of every organic molecule is a string of carbon atoms. (He had developed this hypothesis on his own, as was mentioned in Chapter 2, some eight years ago.) It was the responsibility of the organic chemist to conduct experiments to determine the types and ratios of the elements present in a specific molecule before describing a carbon-string that had just those elements, in precisely those ratios. The description must fit the behaviour of the chemical as seen in the test tube and be internally coherent. Many ('aliphatic') organic molecules, including ethyl alcohol, have this task completed successfully. Benzene, though, was one area where it hadn't. In fact, the seeming conflicts indicated that no such description was possible. The carbon's valency was the problem. Since 1852, chemists have been aware of the atoms' severely constrained valencies. Kekulé had assumed that carbon would have a valency of four and hydrogen a valency of one when he developed his string theory in 1858. By being joined to another carbon atom, a carbon atom in a chain of carbon atoms forfeits one unit of its valency. Ethyl alcohol is often expressed as CH3CH2OH rather than C2H5OH because it has three units left over for interaction with non-carbon atoms if it is at the end of the string and two if it is within the string [9], [10].

Even at the conscious level, it is unclear exactly what was going on here. This is not a description of seeing images in the fire or of mistaking flames for snakes, despite what is sometimes claimed. But was it a reverie or a dream? Did Kekulé witness actual snakes, just forms that looked like snakes, or both? He wondered whether he saw a snake biting its own tail, a simple snaky form curling in on itself, or both. We'll see that it doesn't really matter whose narrative we go with (his experience may have just as well included seeing images in the flames). Whatever phenomenological account of the fleeting, shifting pictures is accurate, it is obvious that the closing of one of the "snakes" was the important aspect.

Yet why? Would the picture of a common children's toy from Kekulé's day, a round hoop, have been as successful? If Kekulé had imagined sine waves, which are distinct serpentine mathematical structures, would his epiphany have come even sooner? It seems unsettling that a snake would grab its own tail, but so what? Why was Kekulé's unexpected awakening so arresting? Modern chemistry ruled the comparable ring-structure to be impossible. How then did Kekulé come up with the concept of a ring-molecule with the help of a snake that chewed its tail? He may have been more focused on the carbon atoms than the hydrogen atoms, as shown by his comment that "This time the smaller groups kept modestly in the background." He let the hydrogen atoms to take care of themselves. But his original vision showed 'long rows' of atoms, in accordance with the chemical theories of the period. How did a snake chewing its tail appear in this string-vision? There are several possible explanations for how Kekulé's seminal snake-image appeared in his head. (Some, but not all, require combinatorial innovation.) Just as a map indicates several routes to go to a certain location, a highly complex computing system provides numerous routes to get there.

A system that allows for many different ways to develop a certain structure or notion is the human mind. Let's say, for illustration, that Kekulé already had the idea of an open curve in his head and that he also had the capacity to examine alternative notions' negatives. As the next two sections will demonstrate, each of these hypotheses is independently tenable. This is a topological idea for "oEN curvE." Concerned with neighbour relationships, topology is a subfield of geometry that comprises a study of knots. An ant crawling on the surface would have to traverse the "equator" to go from one end to the other, a topologist describing an egg would say. Shape and size are irrelevant; for example, a plasticine egg's topological qualities remain same when squeezed, and a reef knot remains a reef knot regardless of how thick the thread is used to tie it or how loose the knot may be.

In contrast to a closed curve, an open curve has at least one endpoint and only one neighbour. On an open curve, an ant can never pass the same spot again, but on a closed curve, it will ultimately make it back to where it started. These 'curves' do not necessarily have to be curved. A straight line, an arc, and a sine wave are all examples of open curves. A circle, a triangle, and a hexagon are all examples of closed curves. From Kekulé's own account of his reverie, it is clear that the words "row" and "molecule" were actively linked in his thoughts. Given his understanding of chemicals, it is quite probable that ‘string' was also triggered. If Kekulé already had the idea of an open curve in his head, this idea may have been triggered as well — perhaps via "string" and possibly even "knots." (We are deferring concerns regarding how mental association works to subsequent chapters since we are taking it for granted at this point.)

It's possible that he had this topological classification in mind. Since it had not yet been created (by Poincaré), topology could not have been formally addressed by Kekulé during his mathematical studies. However, there is some evidence that every young child's mind and conduct are implicitly influenced by fundamental topological ideas like this (thanks to Jean Piaget's study). If this hypothesis is true, Kekulé would have had the capability—in the form of enough computer power—to categorise a string-molecule as an open curve. A tail-biting snake, on the other hand, has a closed curve rather than an open one. So whence did this concept originate? There are several options.

The first is Kekulé's practise of seeing groups and rows of atoms depended on a generic capacity to alter objects in two dimensions, which just so happened to produce a closed curve. This might have triggered the "open curve," which led to the "molecule," via the attraction of opposites that is typical in mental association. Another explanation is that when in exploratory mode, he unconsciously discarded the ‘strings-only' limitation that ordinarily prevented closed curves from arising from his visualising (while thinking about theoretical chemistry). Thirdly, he may have used the heuristic of "considering the negative." We all utilise heuristics, whether or not we have ever heard the term, much as Moleire's character who unintentionally talked in prose.

Heuristics are an example of constructive indolence. In other words, it is a method of problem-solving that ignores less promising options in favour of those most likely to succeed. Many heuristics steer the thinker in one direction rather than another by assuming that the present conceptual space map exists. Others alter the map in various ways beyond only the surface, opening up previously closed avenues. Heuristics as a tool for creativity have long been studied. They were described in Pappus of Alexandria's commentary on Euclid, our buddy from the fourth century whom we met George Polya, a mathematician of the 20th century, identified a variety of heuristics, some of which are so general that they can be used to solve many different types of problems. Advertising agents and management consultants use these heuristics frequently and often explicitly in an effort to promote creative ideas through "brainstorming" or "lateral thinking." Additionally, a number of educational initiatives that are implemented in schools all around the globe employ heuristics to promote exploratory problem-solving.

The majority of heuristics are practical guidelines rather than perfect proofs. They have a decent probability of assisting you in solving your issue, but they could also get in the way on occasion. In chess, for instance, the maxim "Protect your queen" is highly intelligent, yet it will prevent you from sacrificing your queen on the rare instances when doing so would be a winning move. Some heuristics are domain-specific; they are the 'tricks of the trade' used by the knowledgeable expert. In the event that one is not interested, these dealing with a different kind of issue. As poker strategy, for example, "Protect your queen" is worthless. Others are highly broad and may be used to study anything from dressmaking to theatre. Think about how Polya's heuristics may be useful to a casting director or a costume designer, for example. Among other methods, Polya advised breaking the unresolved difficulty down into smaller, more manageable challenges or trying to come up with a comparable problem that one is already familiar with how to solve. He advised asking: "What is the unknown?" if you are stuck. What statistics exist? Have I fully used the data? Do you allow diagramming? Can I create a step-by-step strategy for resolving the issue? Can you please restate the issue? Can I examine the outcome? Can I proceed in reverse? Can I adapt a tried-and-true solution-method to work in my situation? All of these heuristics are applicable to issues outside of mathematics, including play casting and outfit design [11], [12].

CONCLUSION

The benzene molecule was shown by experimental data to have six carbon atoms and six hydrogen atoms. However, instead of six hydrogen atoms, a string of six carbon atoms should really include a total of fourteen. It was unable to overcome the issue by claiming that some of the carbon atoms in a benzene molecule are connected by double or triple bonds since this was incompatible with the chemical characteristics of the substance. There didn't appear to be any way to give benzene a chemically understandable molecular structure. After battling with this issue for many months, Kekulé eventually underwent the event detailed. I slept while turning my chair towards the fire. Once again, I could see the atoms tumbling before my eyes. The smaller groupings behaved modestly this time around. My mental sight, sharpened by several experiences of this type, could now detect bigger structures with various conformations; lengthy rows that were sometimes more closely spaced; and everything that was twining and twisting in a snakelike manner. But observe! And what was that? A snake had grabbed hold of its own tail, and the mocking shape spun before my eyes. I awakened as though by a bolt of lightning.

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CHAPTER 5

UNDERSTANDING THE CONCEPTS OF COMPUTATION

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ABSTRACT:

There are both actual maps and mapmaking. A settlement could be missed, a river might be in the wrong spot, or the contours might be too coarse to be helpful to a rambler. However, poor maps do not prove that drawing maps is a waste of effort, and awkward contours do not negate the usefulness of the notion of contours. Furthermore, maps become better as cartographers learn more about geography and come up with new methods to map it. A mediaeval Mappa Mundi falls short on many counts by today's standards. But even without Mercator's projection or latitude lines, it is still a map. In other words, producing maps is the pertinent activity if we desire a systematic depiction of our area. The same is true for computational ideas and computer programmes. The programmes covered in this book contain a lot of flaws. However, just because modern programmes can't keep up with human mind doesn't mean the underlying theoretical ideas are psychologically unimportant. In fact, many of these ideas are more precisely defined variations of psychological principles that were well-established years before the advent of AI.

KEYWORDS:

Computation, Heuristics, Ideas, Search, Space.

INTRODUCTION

AI employees are just as innovative as everyone else. New computational ideas and programme types are constantly being created. For instance, 'neural network' systems shed significantly more light on combinational creativity than earlier AI research did. It has just been half a century since this science was founded. However, as we will see, even a computational Mappa Mundi is a commendable accomplishment. Similar to how phrases concerning purple-spotted hedgehogs are acceptable in English grammar, some generative systems implicitly define a sentence as a formally organised domain of computational possibilities. Heuristics are techniques for selectively and wisely navigating this area and/or forging new paths within it, sometimes by modifying existing heuristics. Protecting your queen directs you towards certain chess courses while directing you away from others. Additionally, "consider the negative" has the power to fundamentally alter the environment when used at a reasonably deep level of the generative system. As a result, many former places, in fact whole regions, cease to exist and completely new types of locations are generated. For example, Kekulé's study of closed (not-open) curves resulted in the identification of a variety of chemical structures. Schoenberg also took into account the chromatics' experimental potential rather than its tonal counterpart - scale, the option of creating music in a familiar key was gone. Human brains are capable of holding numerous maps for basically identical land, and, gentle Reader, some creative work achieves a mischievous or satirical effect by juxtaposing signposts culled from quite different styles [1], [2].

Both of these ideas are not brand-new. Long before they were used in AI, mathematicians (Pappus and Polya, for example) had explored generative systems and heuristics. Gestalt psychologists like Carl Duncker and Max Wertheimer also looked at heuristics. Indeed, Polya, Duncker, and Wertheimer's discoveries served as a foundation for some of the first heuristic programmes. AI, however, may provide both dynamic processes and impersonal descriptions. As a result, it may aid in the comparison of generative systems and the testing of specific heuristics' computing efficiency in various situations of problem solving. Naturally, the "dynamic processes" are running computer programmes. Computer scientists refer to a programme as an effective method when it is used in conjunction with the suitable machine. An efficient method need not be efficient in the sense of being successful at the activity it is employed for, such as adding, identifying a harmony, or composing a sonnet. Whether or whether computer programmes are successful in that (task-related) sense, they are all effective processes [3], [4].

A set of information-processing stages that are certain to achieve a specific outcome because each step is clearly defined constitutes an effective method. Given the proper hardware, the programme tells the machine what to do, and the machine can be relied upon to do it. It can include a randomising element if a specific step instructs the machine to choose one of a list of random numbers; however, the following step must specify what is to be done next, depending on which number happened to be picked. As Lady Lovelace would have phrased it, the computer will carry out the instructions given to it by the programme exactly. The early AI researchers who first identified heuristics as efficient procedures also created the related idea of a search-space, which is an illustration of what was referred to as a conceptual space in Chapter 4. This is the range of potential states a problem-solver could experience while looking for a fix [5], [6].

'Conceivably' in this context refers to 'per the rules'. Contrary to common opinion, a creative genre may have well defined rules. Music is one example (covered more in this chapter). Western music is a product of a search-space governed by the harmonic rules, and its melodies are routes through a carefully mapped space of intervals. Additionally, there are tempo-related restrictions that define the metrical search space. An appropriate melody (a combination of notes that can be recognised as a song) must adhere to both sets of rules, maybe with some minor adjustments. However, although being obvious, these rules are not self-evident. We'll see that it's not simple to find them and to demonstrate how they enable musical enjoyment. Chess is a subject whose rules are more readily accessible. In this case, the board statements that might be reached by any confluence of legal actions make up the search space. Each lawful move entails a certain action that is specified by the chess rules. Each action is also restricted by one or more prerequisites, without which it is impossible to carry out. For instance, a pawn can only move diagonally while it is capturing an enemy piece, and it can only advance two squares on its first move. Preconditions may be simple or difficult; novices are not taught how to cast in chess, for example, since it contains quite intricate preconditions. Any effective technique that can determine if the precondition is satisfied must exist in both scenarios. Chess masters "intuitively" come up with good moves by recognising common board patterns; yet, every move, regardless of how it was proposed, must comply with the rules [7], [8].

The majority of human thought-processes and the mental environments they occupy are concealed from the thinkers themselves. When compared to problem-solving programmes, whose conceptual spaces can be properly mapped, the kind of thinking that contains well-structured limitations may be comprehended better. As we will show in Chapter 6, imprecise thinking, such as lyrical imagery or the intuitive detection of chess patterns, may also be comprehended computationally. Therefore, in general, AI ideas assist us in thinking more clearly about numerous types of conceptual landscapes. Compared to other conceptual spaces, some map more places and/or more diverse types of sites. a game of chess or any similar search-space. One (like noughts and crosses) defined by just a few actions, each having extremely simple preconditions, is less highly structured and, hence, has less potential than one defined by many different possible actions, some of which have complicated preconditions.

DISCUSSION

Another way to describe this is that the chess search tree is bigger and has more branches than the noughts and crosses search tree. The collection of all potential action sequences that might lead from one legal issue condition to another is known as the search tree. At the decision-points, when the problem-solver must choose between two or more options, the twigs and branches of the tree appear. To put it simply, the search-space maps the locations, and the search-tree maps the routes that may be taken to get there. Certain areas could only be reachable from certain starting points or with specific information. As a result, in the necklace game, you need a certain ready-made necklace in order to calculate "2 + 2 = 4". A novel molecular structure could only be discovered by a scientist who is aware of which atoms may be neighbours.

Hedgehogs with purple spots.

A generative system that can (in theory) produce any place in the conceptual space is made up of data and action-rules. There might be an infinite number of these places. English grammar may produce an infinite number of sentence structures, each of which can be "filled" with a wide variety of word sets, much as the necklace game can produce an infinite number of numbers. Even though the number of potential board locations in chess is limited, it is enormous. Therefore, hardly every place in a big search space can really be visited in practise. The personalized necklaces for the stuffed animals only contain odd numbers of blue beads on each side of the white one, for example. Additionally, certain places may not be related to the work at hand. It can be a waste of time and computing resources to take into account every area, even for a tiny search-space. In general, one wants to find the appropriate way as soon as feasible in addition to doing so.

Both individuals and programmes use euristics to trim the search tree. They prevent the problem-solver from travelling, in other words. By ignoring certain portions of the tree, each choice-point may be avoided. In essence, they change the program's (or the mind's) search-space. They make certain places simpler to go to than they otherwise would be, and they make other places inaccessible that would have been otherwise. Some heuristics are certain to resolve specific problems categories of issues. The problem-solver may sometimes get distracted by others and leave the area of the search space where the answer is. However, the likelihood of accessing the relevant area of the space may be resurrected if the heuristic is regularly considered as temporary or if it can be "playfully" withdrawn.

Simple logical issues were solved by early AI problem-solvers in the 1950s using heuristics, and well-known riddles were translated into logical terms. For example, even these very simple AI programmes were able to crack the "missionaries and cannibals" riddle. Three missionaries and three cannibals have gathered on one side of a river, in case you are unaware of the teaser previously. They have a single rowing boat that has room for two individuals. They are all proficient rowers. Given that there must never be more cannibals than missionaries on each riverbank—for obvious reasons—how are they all going to get across? I'll let you think about this one on your own. It's difficult to accomplish with pencil and paper, unlike the necklace game; try using coins instead. (If you need a hint, consider the heuristic that the French expression réculer pour mieux sauter often refers to.) Since then, a plethora of heuristics have been developed in AI research to turn impractical jobs into achievable ones. Some are fairly wide, while others are very specialized—to science, music, or figure drawing. And as we'll see, some of them have even produced historically novel information. Heuristics are often used in priority order, starting with the most important ones in the search tree. For instance, it is often wise to pay attention to content before organising form. It is usually sane to give priority to accomplishing that item before thinking about how to link it to other things if your present state (your position in the issue space) differs from your goal-state because you are missing a content item.

A practical application of this heuristic is preparing for a vacation; it is better to gather all of your vacation-related items in one place before you begin packing your luggage. Similar to this, logic-problem-solving software often focuses first on the words' substantive meanings before adjusting their exact logical relationships. A different search-tree and a different set of pathways across computational space would be implied by a different ordering of the exact same heuristics. Human expertise entails understanding which specialised heuristics to use as well as when to do so. So, before choosing the pattern arrangement for cutting, a dress designer inquires as to whether the cloth is to be cut on the bias or not. Additionally, a competent musician who is aware with the fugue-composition norms may instantly limit an unidentified fugue to merely After hearing the first note, there are four potential home keys. In other words, using the appropriate musical heuristic right away rather than later in the interpretive process drastically reduces the number of potentially relevant questions that need to be answered.

Flexibility is necessary for handling unique issues. Fugues, for instance, may start out in a manner that deviates from the norm. Successful interpretation of these "rogue" fugues depends on the performer treating the original four-key constraint as only a guideline. An expert musician could do this on a regular basis after learning that composers sometimes disregard or deliberately violate this specific fugue rule. Imagine, however, that a less skilled musician comes across a wild fugue for the first time. By adopting the broad heuristic of discarding a heuristic to loosen the hold of the pertinent rule, the newbie might handle it P-creatively (involving psychological, as opposed to historical, originality). Sometimes it is simpler to say than to accomplish. Human professionals who are accustomed to thinking in a certain manner while doing tasks like painting, composing, or chemistry may not be able to effectively use their own mental resources because they are unable to break specific thought patterns. In normal circumstances, a heuristic that cannot be abandoned or even delayed may be highly helpful. The frozen heuristic may, however, stop aberrant (P-creative) thinking when it is necessary to do so in a different conceptual space. We have shown that a heuristic may sometimes be abandoned, redrawing the map of the search space to include previously unreachable areas. Heuristics may be changed, however. Higher-order heuristics may be used by a problem-solving system, whether it be a human or computer programme, to convert lower-level heuristics [9], [10].

Consider the negative, for example, may be used with other heuristics (such now favourably advocating the sacrifice of the Queen) as well as specific problem-constraints (such as transforming strings into rings, as discussed in Chapter 4). In each scenario, a new search-space that may be very different is formed yet retains certain characteristics of the first. Some of the AI research that will be covered in Chapter 8 is specifically focused on heuristics for modifying heuristics, with the goal of enabling computer problem-solving to build conceptual spaces that are fundamentally different from our own. A hierarchical structure is defined by several generating systems, with some principles being more fundamental than others. In a search-tree diagram, the thickest branches serve as the primary choice-points, while the twigs are produced by the simpler alternatives. One branch may represent a basic restriction, thus cutting it off means losing all the twigs that grow from it, which might represent a significant chunk of the whole tree. Take English grammar as an example. A noun-phrase and a verb-phrase are required in every sentence. The noun-phrase itself may (but need not) have one or more adjectives attached to it. Therefore, "The cat sat on the mat," "The black cat sat on the mat," and "The sleek black cat sat on the mat" are all acceptable phrases. The last sentence would be illegal if some all-powerful tyrant issued a decree prohibiting the use of more than one adjective with any noun (and Dickens could not have written "a squeezing, wrenching, grasping, scraping, clutching, covetous old sinner" without running the risk of both punishment and admiration). However, this neo-English would still be recognisable as a kind of English and understandable. If we did away with the need that a noun-phrase have an adjective, "English" would become much more simplified, with many things only being able to be expressed, if at all (e.g., "The cat has sleekness"), in very different ways. A random string of English words (like priest conspiration sprug harlequin sousewife connaturality) would be no less acceptable than "The cat sat on the mat" if the most fundamental grammatical restriction of all—that there be a noun-phrase and a verb-phrase—were removed.

The same may be said for music. Even if they are odd or narrowly spaced apart, modulations from one key to another are less fundamentally damaging to tonality than completely disregarding the home-key. These illustrations provide a potential response to the query of how one impossible thought might be "more surprising" than another, which is addressed at the conclusion of Chapter 3. The resulting conse- quence is more different and less instantly understandable the deeper the alteration in the generative system.

Conceptual area

In certain instances, the difference is so significant that we refer to a new kind of art or science rather than just a new branch of it, and we give the inventor more credit for inventiveness. Less inventive than conceiving of string-molecules in the first place is the addition of rings to strings as a class of molecular structures. Additionally, shifting from the mediaeval elements of fire, air, earth, and water to the elemental atoms of contemporary chemistry entails a more radical shift than thinking about strings inside the conceptual space of (Daltonian) chemistry. As a result, Kekulé is less significant in the history of chemistry than John Dalton, the man who created the atomic hypothesis. People often assert that because creativity is a manifestation of human freedom, discussion of "rules" and "constraints" must be useless in the context of computer programmes. But far from being the enemy of creativity, restrictions on thought are what enable it. This is true even for creative combinations, but it also more obviously to creativity based on investigation.

Constraints outline a region of structural possibilities that may be studied and perhaps altered to produce another. Dickens' lavish portrayal of Scrooge would not have been possible without embracing and stretching the boundaries of the grammatical rule about adjectives. The little girl would never have been able to add by necklace or come up with the concept of subtracting by necklace if she had been permitted to construct any necklace on that soggy Sunday afternoon. (A necklace may include an equal number of blue beads on each side of the white bead, but "addition" would not be conceivable since anything is permissible.)

Similar to this, it is no surprise that Schoenberg gradually added new restrictions after giving up on tonality, including employing every note in the chromatic scale. Another concern is whether his new restrictions are visually beautiful rather than just cleverly productive. They are not, according to others, since they are arbitrary in light of the inherent characteristics of auditory perception. For example, Impressionism exploits deep aspects of vision; as a result, despite the Impressionists' interest in the science of optics, their work is less "intellectual" than Schoenberg's music. (We will see later that some artistic genres are not arbitrary in this way.) In other words, to remove all current restrictions and refuse to impose new ones is to foster confusion rather than creativity. (As for human freedom, I'll argue in Chapter 11 that it may be interpreted in the same way.

This does not imply that the creative mind is limited to doing a single task. At certain moments, even someone who accepts the existing limits in their entirety will have a choice; in such cases, a random pick will suffice. Bach was forced to do certain things and refrain from doing others because of his own creative choice to write a fugue for the "Forty-Eight" in the key of C minor. He was yet allowed to create an infinitely broad spectrum of subjects while working within those musical limitations. Similar to this, using proper grammar does not need you to express just one thing. Anything is possible when all the limitations have been met. And by "anything," we mean both peculiar decisions informed by the creator's past experiences and totally random decisions determined by the outcome of a coin flip.

It is the partial continuation of limits that makes it possible for a new concept to be acknowledged as a creative contribution by both the author and the audience. The new conceptual space may provide a new perspective on the task-domain and point up intriguing avenues that were previously invisible. In fact, it was impossible earlier Kekulé indirectly established a vast new search space, whose locations (ring configurations) were previously chemically unthinkable, by making a revolutionary idea regarding a single molecule, benzene. However, many of the chemistry-accepted preconditions still held true. These included the need to fit the theory to the experimental data as well as restrictions (such valency) on which atoms may be connected to which.

Similar to how tonality opens up a wide variety of musical compositional options, subsequent improvements and/or modifications open up new ones. The persistent musical norms, such as the return to a home-key or favourite modulations or cadences, provide the listener familiar landmarks with which to traverse the uncharted region, however, until the final break into a totally chromatic search-space. As we have shown, even the flight into atonality may be seen as the culmination of a gradual structural modification of tonal space. This explains why we are hesitant to give credit to others who only had an H-creative, or historically unique, idea - without understanding its importance. Instead than demonstrating astronomical innovation, Copernicus and Kepler's early rejection of the idea of elliptical orbits is an example of cosmic irony. You could believe that making such a comment about these two H-creative geniuses is unfair, if not impertinent. You could want to argue that their analysis of elliptical orbits was "creative but unsuccessful" or that it fell short of "full-blown" inventiveness.

It becomes increasingly difficult to understand the connection between the old and new the more expectations are dashed. This is not only a matter of counting expectations; it also includes determining their generative depth (the search-tree branch at which they originated). A startling discordant chord and an odd modulation may both be accepted and even appreciated by a music listener when they are placed in a tonally recognisable setting. Drop the home key, though, and almost all known bearings are gone; the previous map is destroyed, and it is not immediately clear how to create a new one. Similar to the word-string priest conspiration sprug harlequin sousewife con- naturality, it is incoherent and often useless (save as a stimulant to 'free associations' in thinking). As said in a previous chapter, James Joyce could have been able to make anything of it, but only by creating a brand-new framework for expectations. And he could not have gotten away with it even. Grammar’s complete eclipse. Yes, surprise ideas are creative. They defy what we anticipate. However, something completely unrelated to the familiar causes more confusion than surprise. Both combinational and non-combinational creativity are covered by this. It's possible that the perceived disconnect from what came before rather than a genuine one. However, a person who does not understand the relationship will not be able to distinguish the thought as creative (as opposed to novel). They won't be able to relate it to the issue they had seen as the major issue either: That's not art! Is it considered poetry? It's a tissue made of [chemical] fantasies.

You may infer "Constraints, definitely. Never use computer programmes! But since creativity is a matter of what ideas may and cannot emerge from certain mental structures and processes, anybody attempting to comprehend it must be able to precisely explain these structures and processes and objectively evaluate their generating capacity. Due of this, it's beneficial to Use AI terminology to explain the limitations of human creativity. For if AI-concepts are to be included in a computer programme, they must be well defined. Additionally, any outcomes from the execution of a programme must (again, disregarding hardware issues) be consistent with its promise. It is essential to put generative systems' capabilities to use in this way. Of course, in theory, it is unnecessary. A computer can only do the tasks that its programme and data allow it to. It can only execute "whatever we know how to order it to do," in Lady Lovelace's words. Therefore, without actually running the programme on a computer, someone (God?), with infinite computing power and flawless memory, might evaluate the generative potential of any computer programme. Human computer scientists are capable of doing the same task to a certain degree (just how you could recognise the necklace-game's ability to create all the numbers). However, human programmers are often shocked, but God could never be.

Regardless of how surprised we may be, a program's ability to act is unmistakably shown by the fact that it does so. It is without a doubt rich enough in structural and procedural limitations to allow for such calculations. Let's use music as an example to illustrate how computational psychology might assist in discovering the creative limits present in our thoughts. When you hear an unfamiliar tune (from Western music) and "intuitively" recognise its metre and key, you are engaging in tacit interpretation. When you first hear a tune, you can often begin keeping time with it very fast (you can sense its metre very rapidly). Even if you have never heard the song, you may grimace at the right time if the singer or musician plays an incorrect note before and may not be quite aware of the proper note. If you have musical training, you may make your interpretation of metre and harmony known to the public. Because you can generally write the melody down in musical notation by humming it through a few times [11], [12].

You need the first note to be pointed out for you in the unlikely event that you don't have the gift of perfect pitch. On a piano keyboard, this may be accomplished by touching a specific black or white note. Touching a note won't reveal the home key, but labelling it as F-sharp, G-flat, or E-double-sharp would. The practise may then be completed in "musical dictation." The time signature, bar lines, note lengths, pauses, key signature, and notes may all likely be modified. You will also be able to spot any accidentals, such as sharps, flats, or naturals. You can also tell which is correct and which is incorrect if someone gives you two different transcriptions of the tune, both of which use the exact identical notes on the keyboard and durations. One may, for instance, compose "God Save the Queen" in either 4/4 time in the key of B-flat major or in 3/4 time in the key of A major, commencing with a middle-A crotchet Even to a musical beginner, it is immediately clear that the second form is proper and the first is "crazy."

CONCLUSION

These methods of stating it serve to remind us that the rejected thought did not develop randomly or perversely (as it would have done if it had come from the mind of an illiterate crossing-sweeper or a semi-educated crank), but rather as a result of an intelligent exploration of the relevant conceptual space. They serve to reinforce the idea's validity and fulfil the creative process's evaluation component. But the point is that neither Copernicus nor (at first) Kepler made this assessment, calling their innovative concept "a cartload of dung." The new concept cannot be seen as the answer to the old issue unless someone recognises the structural similarities between the old and new environments. It cannot even be considered the solution to a new issue that is comprehensibly related to the original problem without some understanding of common limitations the earlier one. This explains why unique ideas, even those appreciated by their creators, are often rejected and only embraced by a small group of enthusiasts.

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CHAPTER 6

THE BENEFITS OF CREATIVE CONNECTIONS

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ABSTRACT:

The magnificent unicorn seen in the "Lady and the Unicorn" tapestries in Paris features a horse's body, a bull's cloven hooves, a goat's bearded head, a lion's tufted tail, and a narwhal's long horn. Sadly, despite its heartbreakingly adorable expression, unicorns do not exist. How did the embroiderers, or the myth-makers who inspired them, come up with the concept when they had never seen one? What about the water snakes that are described as being "blue, glossy green, and velvet black," moving in "tracks of shining white," and exuding "hoary flakes" of "elfish light" in Coleridge's poem The Ancient Mariner? Coleridge had never gone to the sea, therefore in addition to never having seen them, he had also never seen any other rare marine species. He read voraciously, and although he sometimes came across "water snakes," he had never seen any with "hoary flakes." What he had discovered was a wide range of sources in many different languages, ranging from technical treatises on optics and the various volumes of the Philosophical Transactions of the Royal Society to Captain Cook's diaries and many other memoirs of sea voyages.

KEYWORDS:

Apple, Creative, Pattern, Snakes, Water.

INTRODUCTION

What kind of brain process could create light-shedding water snakes out of such an odd rag-bag? It's less mysterious to pull a rabbit out of a hat. Regardless of what this mental process is, it may first appear impossible for computational notions to understand it. The way that computer programmes "feel" is considerably different from how artists or scientists describe their own creative moments. People can only explain their conscious ideas, that much is true. Who can say what subliminal forces could be at play? However, the tone of the majority of introspective reports conflicts with the geometry-theorem prover's heuristic approaches (as well as with the exploratory procedures utilised by many 'creative' programmes, including the majority of those to be discussed in Chapters 7 and 8). For instance, the molecular scientist François Jacob said as follows: Reasoning used in modern science fits together like gears admiringly arranges it in a manner akin to a Bach fugue or a da Vinci picture. As in a classic French garden, one strolls through it. Night science, on the other hand, ambles aimlessly. It hesitates, falters, retreats, perspires, and jerks to consciousness. anything is in doubt. ..It serves as a workshop for the potential. ..where ideas go through sensual lanes, winding alleyways, and often, dead ends [1], [2].

'Programme' and 'computer' are most unlikely to be among the concepts that this definition of creative science conjures up. You would think that this is not really unexpected biologically. Why would anybody believe that "night science," poetry, or the portrayal of legendary creatures includes psychological processes that can be quantified by preprogrammed rules? The human brain differs greatly from computers. So it stands to reason that individuals can do tasks that machines cannot.

Computer nerds might probably establish criteria to simulate how "day scientists" solve problems on a regular basis; in fact, there are already several effective programmes for this purpose. They could most certainly programme a semi-mechanical search through a lexicon for rhyme and metre matches, such as "water-snakes" and "hoary flakes." Giving them the benefit of the doubt, it's possible that they may simulate certain types of scientific originality. For instance, inductive procedures could uncover hidden patterns in data or perhaps produce some straightforward mathematical equations. And without a doubt, any AI student could create a concept-shuffling programme to generate a family of fictitious monsters: just enter a horse, goat, bull, lion, or narwhal together with their body, head, feet, tails, and horns; then turn the handle to generate a unicorn. But if the tale didn't exist (along with the charming phrase), we would still have the beast. We may get mermaids if we combine women and fish, but we wouldn't hear them sing. In conclusion, it is foolish to expect scientific and artistic creativity to be described in computer terms, according to the criticism. The term "computation" refers to "following a programme," which is undoubtedly not what the brain is doing [3], [4].

This argument's main discovery is that the brain differs greatly from a digital machine. Knowing this, John von Neumann, the guy who created the digital computer, claimed that "the logic of the brain" could not be like computer programmes. Any scientific explanation of creativity that fails to acknowledge the distinction between brains and digital computers (he speculated that it may be similar to thermodynamics, a concept that is generating a lot of enthusiasm today, as we will see) is destined to failure. The main argument made in the response is that, in certain ways, brains resemble connectionist systems or neural networks, a particular kind of computer model. In connectionist systems, "computation" does not always entail "following a programme" in the conventional sense. We'll explore how the concepts used to define connectionist computing may be utilised to better understand the brain's functioning and how certain elements of human creativity, particularly combinational creativity, are conceivable.

Nevertheless, first things first. Think about those water snakes. They play together in the poem as well as in a masterful literary detective story tale that traces Coleridge's imagery's inspirations. The majority of the answers in this literary mystery, penned by John Livingston Lowes more than 60 years ago, were discovered in Coleridge's personal notebook, where he had scrawled down various thoughts and passages over the course of three years while reading widely. The scholar-sleuth examines the original context of the scrawled sentences in the original texts (such as Purchase's Pilgrimage or the Philosophical Transactions), and may even trawl through the books indicated in the footnotes there. He often discovers different intellectual footprints, strong evidence that the poet has gone down the same road.

Livingston Lowes offers in-depth proof for certain conceptual linkages that Coleridge may have had, which are likely what motivated him to write certain phrases, lines, or stanzas. 'Evidence' and 'probably' are the most we can hope for in studies of this sort, for reasons we will address in chapter 9. The provenance of a specific line or picture may sometimes be proved beyond all reasonable question, but more often we have to deal with the balance of possibilities. Typically, the scholar must make his case to the civil, not the criminal courts. Only when the poet makes a confession is certainty possible, like when Coleridge revealed that the first frame and part of the images in Kubla Khan were inspired by a line from Purchas' Pilgrimage.

DISCUSSION

This is irrelevant to our objectives. Instead of the investigator who inquires as to whether Fred Bloggs stole the jewels, we are more like the crime-prevention officer who queries how burglaries are conceivable. The crime-prevention officer will undoubtedly be able to come up with a few convincing theories as to how certain burglaries may have been carried out. He does not need definitive evidence, however. Similarly, because our concern is how creativity might even exist, we just need to demonstrate that a certain idea most likely originated, or could have originated, in a particular manner. One of the puzzles solved by this meticulous literary expertise is the origin of the water-snakes. Livingston Lowes traces their origins back to at least seven different volumes, as well as to other works that Coleridge is known to have read, using specific passages from the poet's notebook. To show their lineage as thoroughly as he can, he provides several pages of meticulous information, nuanced reasoning (as well as pages of intriguing footnotes), and extensive footnotes. Here, let's simply highlight a few things [5], [6].

A century later still, a Coleridge contemporary wrote of the "tracks" of "sportive" dolphins and porpoises who "gambol on the tide" and whose "tracks awhile the hoary waves retain" in the lengthy and laborious poem The Shipwreck. The term "in mari ludens" (playing in the sea) is used to describe dolphins in a book about Lapland that is written as columns of Latin and Norwegian placed next to one another. Furthermore, a Philosophical Transactions article titled "Luminous Appearances in the Wakes of Ships" discusses "fishes in swimming" who "leave behind 'em a luminous Track" and describes "many Fishes playing in the Sea" creating "a kind of artificial Fire in the Water."

Priestley's Opticks' chapter on "Light from Putrescent Substances" mentions fish that "left such a luminous a track behind them, that both their size and species might be distinguished by it" while swimming. Finally, Captain Cook reported "sea snakes" and witnessed water creatures "swimming about" with "a white, or shining appearance," who in candlelight appeared "green" tinted with "a burnished gloss," and in the dark were like "glowing fire." However, Livingston Lowes was not one of them. The description of the water snakes from earlier in this chapter is repeated here in case these bits don't jog your memory. They were described as being "blue, glossy green, and velvet black," "moved in tracks of shining white," and shed "hoary flakes" of "elfish light."

The iconography of The Ancient Mariner was not created by Coleridge's purposeful quest for allusions to marine animals, according to IvInston Lowes. In fact, he criticises a previous, failed poem in which Coleridge made little changes to similar literate allusions. (Generally speaking, what Hadamard referred to as the preparation phase included active looking; inspiration after that.) But the preliminary research generated a field of meaning from which, as he says, the poet's "extraordinary memory" and "uncanny power of association" developed the beautiful description of the water-snakes. The word "uncanny" used here does not indicate "alien," as Livingston Lowes argued in Chapter 10; Coleridge's mental faculties were simply more developed than those of other people's.

He claims that each stanza's and the poem's overall structure were created by Coleridge's creative imagination. However, the origin of the water snakes was associative, the consequence of what Coleridge himself termed the "hooks and eyes" of memory, and was only partially conscious. Consequently, a single revealing word ('hoary') was recalled from a mass of tedious rhyme; yet, additional terms in the context (such as 'tracks’, ‘sportive', 'gambol', and even 'dolphin') helped the necessary connections. In conclusion, Livingston Lowes defined the poet's mind—and other brains as well—as a profoundly varied and delicately associative mental framework. You could think that compared to unicorns, water snakes are less original or startling. After all, water snakes were known to exist and had been mentioned before to Coleridge's writing. However, there is a unique characteristic of the water snakes (and, upon closer inspection, of unicorns as well) that makes their explanation trickier than it first seems.

Up to a degree, the process of creating unicorns may be characterised as conceptual copying and pasting. It is true that several of Livingston Lowes' own explanations (about dissecting, separating, and recombining concepts) have this feel to them. If that's what combinational creativity entails, a conventional programme of a fairly dull sort may successfully imitate it. For instance, the computerised monster-generator mentioned above may produce several more creatures, such as centaurs, mermaids, and unicorns. Yes, there is assessment involved in choosing a unicorn over another hypothetical beast, and there is a rich background of myth and enchantment that surrounds unicorns. Cut and paste cannot explain the myth or the appraisal (or the neck, as we will discover in a moment). However, coming up with the original concept could appear like a simple task. The descriptions for water snakes are harder to copy and paste. Of course, the poet borrows phrases from other sources, including "water."

For instance, "hoary" and "snakes." The spontaneous connection of these concepts is a phenomenon that has to be explained in and of itself, however, since the origins are so dispersed and dissimilar. How does the mind find the specific concepts at play? Furthermore, the majority of the related concepts are combined rather than pasted together, but rather slightly altered. The phrase "glossy green" used by Coleridge does not appear in any source, but the words "green" or "Greene" do appear in several, and the word "gloss" appears nearby in one. Similarly, the phrase "luminous Track" and "shining appearance" were originally used to describe fish, but in the poem, water snakes are described as having "moved in tracks of shining white." The concepts sparked by the initial sources are combined to create a new picture rather than being employed as pieces in a conceptual mosaic. In these instances of creative fusion, two ideas or intricate mental constructs are fused in some manner to create a new structure with its own unique unity while displaying the influence of both [7], [8].

Knowing full well that copying and pasting would not be sufficient to describe this kind of innovative creativity. The animals of the quiet, in his words, are not fish, snakes, and animalculae, as the Chimaera was a lion, dragon, and goat. Nothing more than a simple combination of things that remain unchanging can account for the facts, in other words. Although conscious memory and reconstruction play a significant role in creativity, they are insufficient. The origin of creativity is the unconscious mind, not the Freudian unconscious of repressed instinct, but rather what Coleridge himself called "that state of nascent existence in the twilight of imagination and just on the vestibule of consciousness." He continues, "The strange blendings and fusings which have taken place all point towards one conclusion, and that conclusion involves operations which are still obscure." We work with the imagination's delicate, unconscious processes. He uses Coleridge's words once more: "The imagination. ..The core of poetry (and, he believes, of science too) is unconscious association, a process that can re-shape ideas as it associations them. The genuine interior creatrix, quickly out of the chaos of components or broken bits of memory, puts together some form to fit it.

It's one thing to recognise unconscious association as a creative force; it's quite another to explain how it works. The "operations" of the unconscious, according to Livingston Lowes, are "still obscure." When he details the many notions Coleridge had in mind and contrasts them with their newly-formed counterparts, he is compelling descendants. He also makes a strong argument when he dismisses simple recombination as a "crassly mechanical explanation." However, he is limited to providing metaphorical and intuitive explanations of how memory works.

Instead than focusing on the underlying process of unconscious association, he focuses on the raw materials and the poetic outcomes. He maintains that creativity is a natural trait of the human mind that can be explained in psychological terms. He also claims that creativity is universal and not supernatural. He does not, however, share our interest in figuring out how to scientifically understand creativity. What exactly are the hooks and eyeballs of memory, how do they connect, and how might they work together to create a unique shape, to put it briefly? Today, a lot of individuals wanted to know whether computer science might assist. If you were to use Livingston Lowes' sarcastic word to describe how you would respond to these queries, you could call it a "crassly mechanical explanation." They may make a case for it based on biology. They may believe that the keys of poetry are in our brains. Computers are irrelevant since they are not like brains. The ability of the brain (with its millions of intricately linked neurons) to facilitate associative thinking is often taken for granted by those who accept this viewpoint. I suppose so. But "can" and "how" are separated by a wide gap. It is not at all clear how the brain facilitates association. For instance, it is not immediately clear how the kinds of imaginative linkage and fusion the literary critic describes might occur. Could computational notions provide light on the nature of poetry?

We must explore connectionist computing to provide an answer to this topic. Computer models: their operation and capabilities. For example, connectionist systems are employed in technology to find patterns in share movements on global financial markets, as well as in psychological (and neuroscientific) research. They are parallel processing systems with computational characteristics that, in a broad sense, are very much patterned after the human brain. They are more taught than programmed, picking up knowledge through 'self-organization' as they go along. They can also do several tasks that are essential to combinational creativity, as we will show. In fact, these factors are important for exploratory creativity as well since they play a role in helping individuals identify the patterns that characterise a certain conceptual area. In examining whether connectionist theories enable us to understand how human beings

What these systems may theoretically perform is what matters. Though fascinating, what they actually do in practise clearly implies (in response to the second Lovelace-question), that it is possible for machines to do actions that seem creative. In addition, it argues that computers could be able to recognise certain characteristics of creativity, perhaps even being able to prefer "a summer's day" over its cold counterpart, as stated by Turing. One exciting aspect of connectionist systems is their potential for "pattern- matching," which is currently possible to some extent in practise. Similar to how you can recognise a face, an apple, or a postage stamp, they are able to recognise patterns that they have seen previously. Furthermore, unlike typical computer programmes, its pattern-matching is very flexible in a variety of ways that find easy analogues in human thinking.

For instance, connectionist systems may do "pattern completion" by identifying the current input pattern as an instance of the original pattern even if it just makes up a portion of it. They exhibit "graceful degradation" in the presence of "noise": if a pattern is input again in slightly different form, they can still recognise it as an example of the original pattern (much as you can identify an apple with a bite out of it as an apple or a ripped stamp as a stamp). (Compare this to seeing a Cox's Orange Pippin after a Granny Smith or a stamp that has a postmark overprinted on it.) They are capable of 'analogical pattern-matching'. In other words, a given input pattern may retrieve a variety of previously stored different-yet-similar patterns, the intensity of which depends on how similar the patterns are to one another (apples are highly evocative of oranges, pears, and bananas, but less so of oranges and pears). These systems also include "contextual memory," which allows an input pattern to trigger not just a related pattern but also certain elements of a preceding context. This is particularly true if the present situation has already partly awakened certain elements. (In a similar vein, you may be reminded of Eve by an apple in a religious artwork but not by one in a still life.) The fact that connectionist models may function with probabilities, and quite sloppy probabilities at that, rather than perfect knowledge is another noteworthy aspect of these models. In other words, they can calculate utilising 'weak constraints'. By weighting a variety of variables, some of which are mutually exclusive and none of which are necessary in and of themselves, they will determine which pattern matches it best [9], [10].

Additionally, many people may improve with repeated exposure to the relevant patterns (much like how someone who was raised in an orchard is more likely to recall apples than someone who has only seen apples once). They pick up on many contextual and semantic links between various representations, which they may then reactivate. Basically, connectionist Systems have 'associative memory' that is based on context and meaning. The most remarkable part is that they act in this way "naturally," rather than having been instructed to. (Similarly, you don't need to be told about apples; neither do you need explicit rules stating the relationship between apples and pears, or even to Eve - although an art historian may be able to help by telling you that an apple sometimes symbolises Eve.) Instead, their associative memory and tantalising, human-like capacities are inevitable results of their fundamental design.

One typical connectionist system's HE DEsIn may be compared to a class of schoolchildren who are asked if anything on an apple serves as the teacher's desk. In other words, the challenge is to identify an apple as an apple, despite the fact that it is somewhat different from every apple you have previously seen. These fictitious kids pay attention, and each is (barely) bright enough to discern if her present viewpoint aligns with that of her neighbour. However, they are very illiterate. No kid understands what an apple is, nor does any youngster understand the distinction between an apple-stalk and an apple-leaf. Instead, each youngster is only capable of comprehending one concept, such as a certain shade of green (or red, or purple), a particular shape, a straight line, a sharp point, a matt surface, or a sweet (or bitter) scent.

Each youngster can't stop talking about the little element that captures her attention completely. The words a youngster hears from her close neighbors—who are chatting to kids in other desks, who are talking to peers in more remote sections of the room—can directly encourage or hinder her perspective. Therefore, any youngster who has something to say that is significant might have an indirect influence on her perspective. Each youngster often modifies their viewpoint in light of what their neighbours have to say (the desks are set up such that students with ideas on issues that are closely related are sitting next to one another). She yells louder the more certain she is, and the more aware she is of her neighbour the louder her voice is. Though there may still be some conflicting, low-confidence facts, the kids' views will eventually be as uniform as feasible. At that time, the classroom is in equilibrium, which is as stable as the group of viewpoints may be taken as a whole.

There is no class captain sitting at a particular desk seriously saying "apple," thus the final choice is not taken by any one youngster. It is the general pattern of mutually consistent mini-opinions held (with high confidence) inside the classroom at equilibrium is the product of the collective whole. Every time the class is presented with an apple (of any kind), the stabilised pattern of mini-opinions is essentially similar, albeit not identical. The instructor can now understand the class's collective response since she is aware of how they all responded when they first saw an apple.

This classroom is, in fact, a "PDP" system (parallel distributed processing) system.3 The class-decision is the result of localised computations that are distributed across the entire community (as an internally consistent set of mini-decisions made by all the children) and are processed in parallel (all the children chatter simultaneously). Concepts are portrayed in PDP models as activity-patterns across a collection of units (children). Different notions (such an apple and a banana, for example) may be actively represented by a single unit. Additionally, different groupings of active units represent a particular notion in various circumstances (for example, an apple in a still life or a Nativity scene). A PDP-unit lacks a well-known "meaning," a notion or idea that can be expressed in a single word or that can be quickly recalled to mind. Instead, it represents a specific micro-feature, which can only be described in complicated and/or technical language, such as a very faint green at a specific location in the visual field of the right eye (this is why PDP processing is frequently referred to as sub-symbolic).

In contrast to 'distributed' systems, 'localist' connectionist computer models, like the one to be detailed in Chapter 7, often feature units coding for common notions. Some brain-cells seem to code information that is more simply articulated, for example, a person heading towards me.) Children of somewhat different kinds relate to various connectionist models and computational capabilities. For instance, the kids may just use the words "yes" or "no," or they could know the difference between "probably" and "possibly." Additionally, they may never deviate from the body of accessible information and sometimes talk at random. (This last arrangement is not as absurd as it sounds: just as Boltzmann's thermodynamics assigns an infinitesimal probability to a snowball's existence in Hell, so a class of children who occasionally speak at random is in principle guaranteed to reach the right decision - though this may require infinite time.)4 These computational distinctions are pertinent to what occurs in the brain. As an example, a neuron may sometimes fire at random or spontaneously without being prompted by the input neurones.

There is a definite division in many connectionist classrooms between the kids who can smell or see what's on the teacher's desk, the kids who can proclaim what it is to the class, and the kids who can't. The 'input' units, 'output' units, and 'hidden' units are the names given to these groupings in the jargon, respectively. For instance, one youngster could only be able to identify a certain shade of green while another may only be able to say that something is partially green. It's possible that there will be a specific row of kids (picture them sat by the left-hand wall) who can each perceive a little feature of the teacher's inquiry, and a different row of kids (by the right-hand wall) who can each offer a tiny piece of the class's response. Thus, it is the responsibility of the kids in the middle rows to serve as a mediator between the two wall rows. The kids in the centre are really shielded from the outside world since they only interact with other kids. Since she just presents the apple to the kids on the left wall and only pays attention to the kids on the right wall, the instructor doesn't need to know anything about them.

Such classrooms may gain knowledge from past lessons and develop an association between two dissimilar patterns (such the visual look of an apple and the word "apple"). Throughout the process, the kids reevaluate the weight they accord certain neighbours' comments. A youngster may choose to ignore one neighbour, even when she is shouting, while paying close attention to another, even when she is speaking gently. These changes are the result of experience. Mary has to be less active to gain Jane's attention the more frequently she engages her, and the more often Mary and Jane talk at the same time, the more probable it is that Mary will interrupt Jane while she is speaking. The internal consistency of the complete collection of mini-decisions will have been maximised after the various levels of confidence granted from one youngster to another have stabilised. Due to the previously learned pattern of connection strengths, a maximally consist- ent class judgement will be made more rapidly in subsequent trials. (Maximum consistency does not imply perfect consistency; in certain classrooms, opposing viewpoints may still be voiced.)

In order to respond with "Orange Pippin" when the instructor says "Cox's," the class may need to learn the complete name of the apple on the teacher's desk, which just so happens to be a Cox's Orange Pippin. Let's start with the lesson. The test follows. The activity levels of the pupils in the left-wall row are 'clamped' in the class to symbolise their hearing the input 'Cox's'. The youngsters in the right-wall row are all required to speak in miniature the words "Orange Pippin" at the same time. Those in the middle are once their pattern of activity settles, they are left to talk to their wallside neighbours and modify their assessments of their trustworthiness. The left-wall students are once again clamped (to "Cox's") during the test. The students on the right wall, however, are not since their neighbours in the centre now control their activities rather than the instructor. The right-wall children's activity is regarded as the "answer" after the general pattern of activity has attained equilibrium. But throughout the class, it was previously established what constitutes equilibrium when the input is "Cox's." In the test circumstance, equilibrium is only attained when the right-wall children are instructed (by their neighbours) to say "Orange Pippin." This is because the levels of trust were in equilibrium (during training) when the instructor ordered the right-wall students to say "Orange Pippin."

A connectionist system can recognise a ripped postage stamp as a stamp because the whole activity pattern, which was initially balanced while seeing a full stamp, is recreated using the stored connection-weights. The teacher's voice will sound a bit different if she has a cold when she administers the test. A somewhat different collection of left-wall children will be highly engaged since the input 'Cox's' will not be precisely the same as it was before. However, the class as a whole return to a condition of equilibrium similar to that which existed before (it seeks the closest match rather than a perfect match). As a result, it discovers "Orange Pippin" as it ought to. In general, these classes react to inputs that have familial resemblances, being able to disregard the tiny differences between recognised individual family members [11], [12].

CONCLUSION

The next day, the same group of kids may be taught a different connection, such as "Golden" and "Delicious." The rationale is because when the input is "Golden," a very different collection of left-wall children will be active, and when the input is "Delicious," a significantly different number of right-wall children will pronounce it. The general patterns of the mini-opinions will be unique and hardly interfere with one another (the children hearing the vowel- sounds for the letter 'o' will be activated in both instances, but the other left-wall children will not). After this instruction, the class is able to respond appropriately to both "Cox's" and "Golden." Additionally, it may be taught a third set of connections the following week. As new patterns clash with the old, the class will eventually become "saturated." However, the size of the classroom will determine when this occurs. The more pattern-associations it can learn, the bigger the class (and the more mini-discriminations it can create.

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CHAPTER 7

THE THINKING PROCESS OF UNROMANTIC ARTISTS

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ABSTRACT:

As we will see, some computer program have already generated useful new concepts. These concepts would have been worthy of respect and perhaps adulation if they had been created by a human intellect. An 'expert system' for one field of biochemistry that is part of an AI program has been used to find research findings that have been reported in a peer-reviewed publication. A new scientific patent was the brainchild of another. And a third has created original works of art that are shown in galleries all around the globe. It does not follow that the answer to the second Lovelace question, which asks if computers may seem to be creative, must be "Yes." In essence, this inquiry concerns whether or not computers can simulate creativity. Additionally, novelty is insufficient to represent creativity. Undoubtedly fascinating are novel (and useful) outputs that were previously unknown to the programmer and maybe to any human being, especially if the unassisted human intellect could not have developed them. They could even provide evidence to support the claim that a certain program has apparent creativity. They do not, however, constitute a program a good candidate for innovation, nor are they required.

KEYWORDS:

Artist, Creativity, Human, Program, Unromantic.

INTRODUCTION

Do any modern programmes represent creativity even remotely as well as a Mappa Mundi from the 12th century does? What can their accomplishments—as well as their many failures—teach us about human creativity? I'll first explore programmes relating to the arts in this discussion before moving on to examples from the scientific field. However, this distinction is not unambiguous. Art does not need empirical verification, but science does (and measurement, if available). The two areas do share a lot of procedures however. For instance, both sorts of domain entail analogy (explained in this chapter) and induction (detailed in the next). Both science and art often use analogies; for examples, consider William Harvey's description of the heart to a pump or Ernest Rutherford's depiction of the atom as a miniature solar system. Similar to how learning to identify illnesses needs inductive reasoning, so does learning to distinguish between various musical or artistic forms [1], [2].

They are not required because psychological creativity (P-creativity), as discussed in Chapter 3, often yields concepts that are not historically unique (H-novel). They are insufficient as, as we discovered while talking about the geometry-program at the conclusion of Chapter 5, a fresh (and unexpectedly beautiful) result can have been produced in an unimaginative manner. Whether a programme exemplifies exploratory creativity relies more on how it functions inside than on how innovative its results are. Which procedures explored, tested, mapped, and/or transformed the conceptual space that the programme in question was occupying is the key issue [3], [4].

We must be clear on the purpose of the exercise before moving on to any examples. Whether or whether computers can "truly" be creative cannot be the aim of the fourth Lovelace issue.

Since it is not my main issue, I will only address it in the final chapter. You may assume that the goal is to provide a solution to the second and third Lovelace issues, which are whether or whether programmes can look to be creative and how to identify creativity. But even those Lovelace-questions are only taken into account in this context for the insight they provide into the first: how computational notions might aid in our understanding of our own creative processes. My goal is to shed light on how people manage their creativity rather than bestow praise on computer programmes. These two chapters are not intended to create a rivalry between different programmes or individuals. If they did, we would triumph without a doubt. The continued safety of the Nobel Prize and the Prix Goncourt for humanity will be amply shown. For our objectives, contemporary AI programmes are not only weak competitors who should be mercilessly pummelling or violently wrestled. They are also not obnoxious imposters who should be constantly made fun of. Instead, they serve as early explorers pushed into uncharted psychological land. Their adventures—successful or not, 'humanlike' or not—help us to think properly about our own thoughts [5], [6].

This may seem like a rather uninspiring field for computer creativity. Computers are undoubtedly a common tool for artists, sometimes even as tools for creativity. "Computer music" uses sounds that are distinct from those produced by orchestral instruments and enables composers to experiment with chords and phrases that they may not have otherwise considered. Images of captivating beauty may sometimes be produced by "computer graphics" (including computer animation), which also enables human artists to produce innovative visual effects. Additionally, "writing-programs" assist both adults and children in structuring and producing writings of a complexity and coherence that they would not have been able to do without them.1 However, the human person is a crucial (hands-on) component of the exercise in the majority (though not entirely all) of these circumstances, seeding, revising, and sorting the output in question. The person is sometimes not present. For instance, entirely automated methods are used to create pictures like the Mandelbrot set, which includes new forms of internal structure on an infinite number of layers.

They are really gorgeous in brilliant technicolour, and exhibits of them have been held in art galleries as a result. They do, however, have a chilly, mechanical quality. More specifically, the computational mechanisms involved are so unlike from human thought that they are of little psychological relevance, save inasmuch as they demonstrate the possibility of unforeseen complexity easy procedures. (The mathematical formula z z2 + c is repeatedly calculated to create the Mandelbrot set, with the results of one calculation being used as the input for the next.) Not 'inhuman' programmes like these, but those created specifically to highlight the originality of human artists like painters, poets, singers, and writers are what we are worried about. The Mon The most popular of these programmes up till now are a number of drawing programmes created by Harold Cohen.2 Before he started creating programmed art, Cohen was already a well-known painter, with canvases on display at the Tate Gallery and many other institutions. However, the term "turning" may not be appropriate since, in retrospect, his current interests represent a very predictable progression of his creative career.

DISCUSSION

In the sense that they did not show recognisable items (as in a still life) or even fantastical objects (as in a Bosch or a Dali), Cohen's own paintings were abstract. But since everyone, including himself, saw them as images of adjacent and overlapping surfaces or solid things, he developed a keen interest in the cognitive processes behind such interpretation and representation. He continuously created fresh versions and new aesthetics in an effort to better understand how we react to them on an emotional and perceptual level. For instance, he looked at how people react differently to open and closed curves, as well as various forms of symmetry and colouring. In other words, he methodically investigated the mental space that interplay between line, shape, and colour creates in our thoughts. His latter interest in computer-generated canvases was primarily motivated by his long-standing interest in the psychology of painting [7], [8].

Cohen's developing opinion that art is mostly regulated by rules was a second factor. In order for (for example) a line to be extended in a direction dictated by some existing, and often entirely random, characteristic, he had experimented with several painting 'rules'. He said (in a BBC interview) that "I think at each stage in the painting, I am placed in a new situ- ation where I have to make a decision in relation to what's already been done..." shortly before turning to programmed art. And he said (in a statement to the Arnolfini Gallery): "I'd always get to the point in a painting when I'd have to decide whether to make it red or yellow. I sought to get a hue that was as unambiguous, positive, and random as the design. (Notably, he noted a few years later that a programme for creating maze-like structures "had the unusual outcome... of obstructing the path, which was rather fascinating because I could not find any logical foundation for a colour organisation in it, colour has been the source of my long-standing obsession. So it should come as no surprise that Cohen set out on a journey of computational exploration. Perhaps more unexpected is the artistic quality of the outcomes. Cohen's computer-generated artwork is shown and purchased all around the globe, and not only for its novelty value. His abstract landscape-inspired creations, for instance, were included in a special show at The Tate Gallery in 1983.

In order to handle growing aesthetic complexity and a widening breadth of subject-matter, Cohen's programmes are continuously improved. For instance, the ANIMS programme that created bulls subsequently had the ability to create. His most intriguing computational effort to date is a programme, or rather, a group of programmes, named AARON. This project is intriguing from both an aesthetic and psychological standpoint. He develops. The nature of the programme and the conceptual environment it resides in may be drastically altered from one iteration of AARON to the next.

The early AARON focused on impulsive drawings of abstract shapes that, to the spectator, sometimes seemed like pebbles and twigs lying on the ground and, on rare occasions, weird birds or bugs. In its ideology, human figures were not even contemplated. The Frontispiece, in contrast, displays a drawing that was purposefully created by a more experienced version (of 1985), whose aesthetic universe comprises many more difficult species. Later, AARON continued to make drawings that were increasingly intricate, showing groups of people amid a tangle of greenery produced in 1989, is one of the program's most recent illustrations and contrasts the Frontispiece acrobats' two-and-a-half-dimensional figures with completely three-dimensional human figures. I called acrobat-AARON's drawings "deliberate" and abstract-AARON's "spontaneous" since only acrobat-AARON can decide in advance what kind of image it will make. ARON creates its landscape drawings by selecting a random beginning place on the page, moving beneath the control of a set of IF-THEN rules that determine what should be done next in any given circumstance. AI employees refer to this system as a production system. For instance, whether a line is a part of a closed form or an open one will determine if it should be continued and in which direction. The IF-THEN rules of Abstract-AARON could be somewhat complicated. Before the programme understands what to do next, many (and not just one) elements of the drawing's present state may need to be examined.

The programme may thus be trusted to make locally coherent judgements (including random activity at specific defined moments), assuming the rules are rational ones. However, it is unable to expressly take the whole scene into account. It is unable to recall its prior activities, thus it cannot even learn from them. In contrast, Acrobat-AARON has the ability to lay out certain components of its drawing before beginning. Additionally, it may verify that the intended limitations are being satisfied while it is being executed. Although it is just as autonomous as abstract-AARON, it is less spontaneous.

To get a feel of the conceptual areas at play here, think about how you could approach creating an artwork titled "Acrobats." Balls', etc. It is necessary to choose and carry out a certain composition and content. However, the general creative style must be chosen before putting pencil to paper. Assume for the moment that we want a loose, realistic, pen-and-ink line drawing similar to the one in the frontispiece. For a while, try to draw anything in such manner. The exercise should be instructive even if you are a really bad draughtsman and are forced to replicate the Frontispiece. Next, attempt to write out some suggestions that may aid a friend in creating such an image; ideally, this person has not yet seen any of Cohen's work.

Which kind of recommendations may be on your list? Since there is no shading allowed (although a very limited amount of "hatching" is permitted), your execution tips won't contain any constructive advice on shading. However, you may point out that your buddy must express occlusion by interrupting the outline of objects hiding behind other (non-transparent) objects if solid objects are to seem solid. (The convex surface of the middle acrobat's left knee is not shown by a line in the Frontispiece because the left wrist and hand are in front of it.) There are just a few (perhaps optional) hints to the clothing and facial features since the body's outlines are the aesthetic focal point. Noses seem to be standard, but lines that imply footwear are not. Body forms don't have to be as realistic as they would be in a Baroque cartoon. However, they must be somewhat realistic; for example, no late Pissarro portraits with both eyes on the same side of the nose or late Pissarro limbs shown as linked wedges or triangles.

Additionally, there cannot be any poses that defy gravity, such as human figures floating horizontally in the air as in Chagall's dreamlike scenes. The rules of gravity also apply to the balls. Additionally, their position—whether it be in the air, on the ground, or supported in some other way by the acrobats—must make sense in terms of the body postures of the human figures. These attitudes are shown not only by the angle and placement of the limb-parts but also by the muscles that are foreshortened and/or protruding from them (see the left upper arm of the balancing acrobat in the Frontispiece).

Regarding composition, it is necessary to somehow indicate the ground plane; yet, there should be no horizon line or other overt indication of ground level. There cannot be a trio of little figures crammed into the upper left-hand corner; the design must take up the whole area of the page. The whole image has to be symmetrical or visually balanced (but not excessively symmetrical, since it would make the Mandelbrot set unnatural). And every single piece of material must be essential to the overall composition. For instance, the balls must not seem to be unneeded garbage scattered on the ground, even if they are not really being utilized by the acrobats in any manner. Clearly, by checking off each item on this list of dos and Don'ts would not be a simple process. It would be much harder to instruct your companion on how to carry out the necessary tasks and stay clear of the dangers mentioned.

Writing a computer programme that can draw 'Acrobats and Balls' in an appealing way is a great deal more difficult. The programmer must not commit fraud by including just one compositional form or one image, built in line by line (like a poetry to be repeated aloud). Additionally, he cannot get away from the accusation of cheating by including seven compositional forms and twenty photographs. Instead, the software should be able to produce an endless number of images of the same overall style. By creating images that have never been created before, it should never cease to amaze us. Even if some of these drawings will be less than others, only a small number should be clumsily unacceptable, and none should be visually uninteresting.

Cohen has succeeded in doing this. Every version of AARON has the ability to instantly create new images. The organizers of the world fair in Tsukuba, Japan, gave Cohen 7,000 drawings that had been created there; each was distinctive and had never been seen by him before. They have also made many people happy all around the globe. Because Cohen's program generates pleasing-to-the-eye outcomes. It is not comparable to a dog that is able to stand on its hind legs, about which Dr. Johnson once stated, "The wonder is not that it does it well, but that it is able to do it at all." Of course, it's not Leonardo. And I'll be honest—I selected one of my favourite to serve as the frontispiece.

Not all of AARON's acrobat images are as appealing as this one; in my opinion, the two compositions are not. But almost all are pleasant, and many get spontaneous acclaim from those who are unaware that they were produced by a computer program and may be reluctant to accept this. This model is entirely computational, as opposed to the articulated wooden models sometimes used in painters' studios. It consists of a collection of procedures rather than a list of facts. The body-model developed by AARON is a hierarchically organised procedural schema that defines a search-tree that may produce an endless number of line drawings to depict a broad variety of physical situations. In other words, it creates a conceptual space (or a group of related conceptual spaces) whose potential is both formed by and constrained by the relevant restrictions.

Certain restrictions are unavoidable; for AARON, everybody has two arms and two legs. No "funny men" allowed; the program cannot depict a one-armed acrobat. Undoubtedly, the right arm of an acrobat need not be included in the final drawing; it may, for example, be concealed behind someone's back. But in AARON's original design, it would have been part of the image. That is, its body-model only instructs it on how to design individuals with two arms. One-armed persons are categorically prohibited from The body model for AARON would need to resemble a computational frame with a slot for "number-of-arms," whose default value would be "two," but which might take "one" and maybe "zero" as well. If Cohen were to give AARON with this slot-filling mechanism, could the program then proceed without further modification, dependably creating attractive images, or would further changes be required?

The body-schema of AARON has additional context-sensitive limitations. The nose, for instance, determines which direction the head is oriented. Because of this, noses are a given in the illustrations created by acrobat AARON. The body-model that underlies similarly, whether or not the limbs are foreshortened or the muscles are visibly flexed depends on the particular bodily attitude and/or viewpoint. The limb's ability to bend relies on a variety of factors as well. The body-schema of the program depicts the joints and their range of motion. However, a leg's position changes depending on whether it provides the body's sole support and if the ground or a curved surface is underneath it. If it isn't the only support, AARON needs to know what else is involved. Similarly, the whether an arm is supporting, tossing, catching, or utilised to balance the acrobat's body will determine how it should be positioned. (Cohen would need to change the balance-related heuristics if the 'one-arm' alternative were to be included, as mentioned above.) The overall composition is a factor that AARON takes into account while deciding how to pose the limbs. The third acrobat (pirouetting) has the left arm lifted and the right arm extended for reasons other than only body-balance limits.

AARON would need to be knowledgeable about colour to create paintings in addition to sketching. However, as human artists are well aware, the aesthetics of colour are relatively subdued. Jungle-Aaron would probably need to be aware of certain color-facts, like the fact that, while being in the tropics, the ground is not sugar-pink (a fact that Gauguin sometimes willfully ignores). However, even abstract-AARON would need a basic understanding of the rules regulating the aesthetics of adjacent colours in a painting. Due to the obscurity of these ideas, Cohen did not attempt to include colours in his early drawing programmes. He worked on the issue for a long time (Cohen personally painted the coloured versions of AARON's drawings that are on display). A coloring-machine prototype was tested in the spring of 1990, and a revised model was shown 10 years later. Then, AARON had developed into a painter as well as a draughtsman at that point.

The common knowledge that AARON already holds has to do with things like how to depict lighting, solidity, or occlusion in a line drawing. This can seem to be rather easy. For instance, occlusion calls for the artist to break up the lines that represent the object's surface edges. But where exactly should the interruption begin and end, and on whose lines? The computer programme must choose a certain perspective that will be maintained throughout all the objects in the picture in order to respond to these specific inquiries concerning execution. Hatching near to an edge-line is used to portray solidity and lighting in a similar way. Which edgelines, though? The fact that all of the hatching is on the same side of the closed shapes in question suggests a direction of illumination; nevertheless, in the Frontispiece, the arms of the seated acrobat are hatched on the opposing sides. These are two quite different types of hatching, to be sure, but wouldn't it seem silly if the acrobat's inner arms were both hatched more heavily? Yes, perhaps. This is precisely the type of query that is characteristic of exploratory creative thinking [9], [10].

How the artist may depict the ground plane is also a concern — if a horizon line is present or not. Perhaps the spectator and acrobat AARON are only able to make sense of the Frontispiece because of past knowledge of the anatomical stability and relative proportions of humans. (How could AARON depict the recognisable kid acrobat without confounding the ground-plane?) In the jungle painting of the ground-plane is indicated by strewing pebbles on it. The young Picasso's circus-pictures contain several drawings of child acrobats.

The definition of compositional balance, or aesthetic symmetry, is the subject of a third exploratory inquiry. Without the pirouetting acrobat, the Frontispiece would seem quite off, and much like ‘realistic' designs, abstract ones are subject to compositional limitations. All of these issues have to be taken into account by Cohen while writing his programmes. "Cohen gets three cheers!"', you could sob. There is no denying Cohen's own creativity. His programmes also enable us to more clearly explore some of the mental processes that go into human artists' drawings of abstract shapes or acrobatic performances, which is ultimately what we are most interested in. But are they capable of becoming creative themselves? Are they strong contenders for the appearance of creativity, or should I say, given we haven't asked the fourth Lovelace question, are they? what Must a programme look like, therefore, in order to seem creative? Given that we are thinking about exploratory creativity (as opposed to combinational creativity), it must occupy and explore a conceptual space that is sufficiently rich to provide an endless number of surprises. It should ideally expand this area – or might even create another one to escape from it.

It must result in P-novel outcomes, and ideally H-novel results as well. Even while each solution could have an own conceptual approach, the results must often be unanticipated in isolation. They must be produced solely by the programme, using its own computing capabilities as opposed to continual input from a human operator (although specific "commissions," such "Please draw two acrobats with one ball," are still permitted). Additionally, the calculation of the programme must entail discretion. More people should engage in purposeful action than random events, and any unpredictability must be regulated by the basic characteristics of the relevant creative area. When determining what to do next, the programme should ideally have the capacity to sometimes reevaluate its prior decisions (although, as we will see when discussing jazz improvisation, this self-critical ability is not always present even to human designers).

We must be able to recognise the newly created structures from the programme. It must have a method of assessing different potential structures for itself in order to prevent absurdity and, preferably, cliché. In the case of AARON, this means that it must be useful in some manner. (If it slips up now and again, that's understandable; what human artist or scientist does not?) The more human creativity is highlighted by the relationship between the program's generating techniques and its outputs, not to mention the creativity of individuals who interpret the innovative concepts, the better. In fact, this is what counts from our perspective since we are only interested in "creative" computer programs—that is, programmes that at least seem to be creative—to the degree that they provide light on human psychology.

With one crucial exception, AARON satisfies all three requirements for creativity. Each of its freshly created drawings is a historical uniqueness since they are all different. However, its drawings only qualify as H-novel (or even P-novel) in the strong meaning defined in Chapter 3 if we consider the numerous AARON iterations to be a single computing system. Regarding the talents of abstract-AARON, the drawings of acrobat-AARON could not have occurred in the past, and acrobat-AARON also could not have created the jungle scene. However, the situation is different if we simply take into account one version of the programme: each drawing might have been produced (by that version) in the past. Furthermore, Cohen is solely responsible for the transition from abstract-AARON to acrobat-AARON and finally jungle-AARON; the programme did not modify itself on its own.

As a result of its somewhat conservative exploration of its own conceptual space, AARON's originality is not particularly radical. Any given version of AARON has more inventiveness than the youngster who keeps saying, "Let's make another necklace, with a different number of beads in it," as opposed to the child who complains, "I'm bored with addition-by-necklace!" an hour later. Let's tackle subtraction now." Unlike a toddler, who could attempt to do "1 + 1 + 1" or build a necklace out of just seventeen beads, the programme is not looking to push its creative boundaries. It is not unexpected that it does not attempt to alter its limits because it cannot test them in these ways. It investigates but does not alter or change. AARON is comparable to a human artist that has honed their craft and is remaining true to it. This accomplishment is not to be disregarded since the preferred style may enable the construction of several other images (or poems, or melodies), each of which is appealing in its own right. But it isn't adventurous.

A creative drawing program should ideally be able to develop new styles and/or change material as needed. It should be able to think, possibly like Picasso, "I'm tired of acrobats! Instead, I'll make some Minotaurs. I also want to experiment with a different approach, so I'll try sketching the different portions of the limbs as straight-sided geometric figures to see what emerges. The programme would need the essential forms of knowledge in order for this to be feasible. In order to explain, contrast, criticise, and modify such knowledge, it would also need a method of reflection. In other words, it must be able to create, examine, and modify different mental maps. No one who doesn't know what the Minotaur looks like can sketch it in terms of content knowledge. Understanding how it moves and maintains itself is necessary for this. Cohen could have furnished AARON with Minotaur body-schemata if he had done so. It sometimes changed the subject matter of its photos.

Human painters are also capable of drawing other objects and, sometimes with the aid of combinational inventiveness, they may conjure up previously unheard of stuff, such as unicorns and water snakes. However, they have the advantage of years of experience over Aaron, which has allowed them to acquire richly related representations of a variety of things. They are also better than AARON at combining symbolic and visual elements, as seen by the unicorn's endearing look and the Minotaur's mythical significance. To modify an artistic style, AARON would need to have the knowledge of, for example, the visual comparison between a straight line and a soft curve, and therefore between a thigh and a wedge or a triangle. (Many humans cannot see this analogy until some- one like Picasso points it out to them, and even then they may resist it.) It would be relatively easy to provide AARON with this systematic deform- ation of curves into lines, but more di□cult to enable the programme to generate it (and other stylistic variations) unprompted.

Imagine, for instance, that no human artist had ever drawn acrobats with triangular calves and wedge-shaped thighs until AARON did it. Some sceptics might obstinately reject the drawings rather than approaching them with an open mind. They may be obliged to acknowledge that there is some similarity between limb-parts and wedges. However, it is completely dull, and the illustrations made from it are horrifying.' And this bias would endure. Tolerating such impertinence from a computer programme, in their opinion, is fundamentally different from allowing a human artist to challenge our views and upend our comfy aesthetic traditions. This mindset is fundamentally unrelated to the inherent qualities of the program's illustrations. Instead, it is based on the assumption that, notwithstanding the novelty that may be produced, no programme can really be creative (in response to the fourth Lovelace question). The (factual) concerns of whether programmes may look creative and if they might provide information on human creativity are unaffected by this. Therefore, like any computer performance, Aaron's performance is, in theory, unrelated to the fourth Lovelace issue. However, it offers us a solid justification for responding "Yes" to each of the first three Lovelace questions. We should have greater justification in later iterations [11], [12].

CONCLUSION

These restrictions on AARON's inventiveness are well known to Cohen. His ultimate goal is to create an AARON that has the ability to change how it draws. It will be simpler to provide for minor tweaks to an existing style than to invent a whole new one. To transition from one style to another, one must make very basic changes to their generating processes without losing overall coherence. Self-criticism is necessary for any kind of style change to occur. AARON lacks the ability to evaluate and change its own actions. Only a few programmes can currently achieve this these systems contain heuristics for promisingly altering conceptual spaces, including heuristics for altering their own heuristics. In theory, therefore, a future version of AARON may automatically create a beautiful drawing that it was previously unable to achieve. Even if the drawing were less imaginative than a Matisse and less stunning as a Leonardo, creativity is a question of degree (and most people are not very creative). Such heights are unattainable for human artists). In such case, AARON would have fulfilled everything that could fairly be expected of an ostensibly inventive programme. Of all, some people still hesitate to describe Aaron as "creative." In other words, they would cast doubt on whether AARON really comes off as innovative. They could attempt to defend their decision by citing the program's inherent aesthetic appeal, or lack thereof.

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CHAPTER 8

THOUGHTS OF A COMPUTER SCIENTIST

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ABSTRACT:

This story is made up. However, it is not a fairy tale. The owner was in need of a genie or fairy godmother, but neither existed. Instead, he had asked a computer program for guidance, paying a lot less than he would have for a meeting with a real expert. It's also not science fiction. It is not predicated on a wild leap of the imagination like a time machine or an anti-gravity machine. Because a computer program currently exists that identifies most soybean illnesses almost perfectly and outperforms the "textbook" technique suggested by the global expert, 'Intuitively', agricultural specialists can identify soybean illnesses. While the 19 common illnesses may be distinguished from unusual ailments by clearly visible characteristics including the plant parts afflicted and the anomalies they exhibit. For example, leaf spots might be big or little, have halos or not, and have wet or dry edges. In general, a straightforward (one-to-one) relationship between a symptom and an illness is absent; instead, each disease has a distinctive pattern of symptoms that human experts may identify. Individual farmers may get the professionals' guidance for a fee. They often explain their issue via phone contact or mail. The farmer, however, may not be aware of all the warning indications. Furthermore, the expert may not always be able to ask the precise questions that would provide the solution right away (even if he were to visit the farmer's fields and instantaneously address the issue). As a result, AI professionals recommended that a specialized AI program (also known as a "expert system") would be useful.

KEYWORDS:

Bacon, Computer, Human, Program, Scientist.

INTRODUCTION

They requested information from a well-known expert on soybean disease on the sources of his diagnosis. He discussed his intuitive ability for several hours, becoming as specific as he could. His suggested diagnostic techniques, or heuristics, were later implemented in a computer program. They were portrayed as a series of IF-THEN rules that connected facts to logical inferences, such as: IF there are enormous leaf spots, THEN it may be one of these illnesses, but not one of those; IF the leaf spots have yellow haloes, THEN such-and-such diseases are ruled out, but these other diseases are feasible. To utilize the program, a farmer would explain their issue using a questionnaire that included the pertinent aspects. When tested on a set of 376 instances, the program correctly diagnosed 83% of them. This data would then be entered to the program, which utilized its IF-THEN criteria to determine the diagnosis [1], [2].

Most likely, you are unimpressed. Aside from the 17% mistake rate, the human expert specifically specified each rule that the program employed. Being unable to learn, it had to be taught everything. This program, more than any other, is open to Lady Lovelace's critique that it can only do what we tell it to do. All people are unique. With enough practise and exposure to a range of instances and counter-examples, a farmer may learn to recognise soy-bean illnesses. No clear guidelines must be given by his instructor; if he does, some of them may even be in conflict with one another. Instead, he highlights the characteristics that are pertinent to the diagnosis in each specific instance, such as spots and other abnormalities. People are able to P-create their own notions with this kind of assistance [3], [4].

'Frog eye leaf spot' was certainly a term the farmer was unfamiliar with before. Even if he had, he would be unable to identify it. He was unable to find it anywhere on any mental map, not even implicitly. He can now. He does this by employing simpler ideas, some of which may be freshly learned, such "water-soaked margins." He often learns not only which routes to take while travelling in the unfamiliar environment, but also in what sequence. For instance, he could decide to search for halos rather than worry about water-soaked edges since they provide more information about soybean disease. In general, one's capacity to articulate the structure of a conceptual space one inhabits is restricted; hence, even if the soybean-specialist strove very hard to communicate his knowledge in explicit form, the resultant rules were successful. (Whether he is aware that he is thinking in this manner is another thing.) As we saw in Chapter 4, the capacity to reflect on one's mental processes starts in early infancy; by definition, it is a step behind those mental processes themselves; yet, in just 83 per cent of instances; evidently, significant expertise remained tacit.) You could think that the expert system should act more like a farmer and that the least one might expect from a "creative" program is the capacity to discover new ideas from direct experience. So, this request has already been satisfied. There are any inductive reasoning models that have developed freshly defined general principles based on collections of specific cases. Soon, examples of well-known instances of scientific H-creativity will be examined.

Soybean-disease

In a pioneering use of automated induction, 307 sick soybean plants were identified using the questionnaire in Figure 8.1, and each one had a human expert diagnose it. The 307 description-diagnosis pairs were then fed into a simple inductive program, which looked for patterns in the vast amount of information that was given to it. Following this training session, the program was put to the test using a new set of plant descriptions (this time without any pre-made diagnosis attached). Only two of the 376 instances it was tested on had the incorrect diagnosis. In other words, its rules developed by itself were almost 100% accurate. The newly developed diagnostic criteria of the inductive program outperformed the 'textbook' approaches of the human expert (embodied in the soybean-program mentioned above), which only achieved 83% success on the identical test-set. The modified soybean program, which is currently regularly used as a diagnostic tool in the Illinois agriculture service, was created using the rules established by the program. As we've seen, a need for innovation is positive value. A program that performs a task with a high probability of social benefit should not be dismissed. Additionally, simplicity is often important when evaluating new ideas, not just percentage success. Instead of a collection of random rules, the inductive program provided an idea that had been carefully created. In fact, as we will show, its freshly created idea of soybean illness was the greatest possible representation of the facts provided to it. The requirement of elegance seems to have been reached [5], [6].

How was this feat accomplished? In contrast to the above-mentioned "expert systems" left the inductive program with no substantial knowledge about soybeans. Regardless of the topic area, it employed a purely logical method to find abstractly defined regularities in the data. To put it simply, it looked at the data to identify qualities that were consistently (or sometimes, or never) linked to a certain illness, making sure that all individual features and diagnoses were taken into account. Many inductive programs use this strategy, known as the "ID3" algorithm. (ID3 can also 'tidy up' a set of human-derived rules, like those used to create the 83% successful soybean-program, by highlighting any hidden inconsistencies.) As long as the number of pertinent properties does not exceed the point at which even a computer would experience information overload, ID3 is guaranteed to find the most effective classification strategy in a given domain. In other words, there is a mathematical demonstration that the algorithm can theoretically achieve this given enough time and memory. However, the collection of specified attributes must include all of the relevant ones, albeit not necessarily the only ones. Contrarily, a farmer could recognise the significance of yellow halos even if they are never specifically explained to him.

DISCUSSION

This logical approach allows a learning program to efficiently form a "classification-by-property" conceptual space and identify the quickest route for discovering instances inside. The program defines the most effective tree-search in addition to the appropriate search-tree using the language given in Chapter 5's glossary. It learns to ask the appropriate questions in the proper sequence so that it can determine (for example) which of the 19 soybean diseases affects the plant in question as rapidly as feasible. This somewhat relies on how many instances of each class (illness) there are overall in the sample set. Consider the scenario where the presence of yellow halo is sufficient for the diagnosis of frog eye leaf spot. It does not follow that the most effective decision-procedure will begin by checking for yellow halos, even if it is as simple to check for them as for any other attribute (which in practise may not be true). For only a very small fraction of plants with frog eye leaf spot may have that specific characteristic. Yellow halos may not even be a required component of this illness [7], [8].

Sometimes it seems sense to put other attributes first. This would be the case, for instance, if frog eye leaf spot instances were relatively uncommon on soybean fields. These kinds of statistical features may be found via the ID3 method and subsequently used. It is obvious that a representative sample must be presented, one in which common illnesses prevail and uncommon diseases are correspondingly underrepresented. If not, the diagnosis it learns to make won't be trustworthy. How does using such a program compare to training a human farmer to identify plant diseases? Similar to him, it is now capable of diagnosing conditions that it was unable to do before. Like him, it too relies on a representative sample of soybean illnesses for its trustworthiness. But there are also differences. The program is able to search far bigger example sets than we are able to since it does not have the short-term memory restrictions that humans have. Negatives and disjunctives are not particularly difficult for it to comprehend. The fact that a disease does not entail a certain symptom or that a plant with that illness would exhibit either this symptom or that symptom is, in contrast, rather difficult for humans to apply. Additionally, it disregards the reality that certain pertinent qualities are less obvious and harder to discern in practise than others. For instance, it is unaware that smaller spots are harder for people to perceive than bigger ones. In essence, P-creates notions in a fairly robotic manner.

However, this does not imply that the program is psychologically unimportant. People may use its overall strategy (or logical approach) deliberately or unintentionally. In fact, psychological studies on how individuals absorb ideas were the original sources of inspiration for the inductive algorithm. It demonstrates how a theory of human concept-learning that used search trees and computations similar to those in the program while also accounting for short-term memory might be used to explain a broad range of human accomplishments. Additionally, it provides psychologists with a precise theoretical framework within which to investigate various "weightings" of features with various degrees of perceptual salience. These facts concerning ease of (perceptual) processing may be expressed in the relevant computational theory if yellow halos are so obvious that they 'strike one in the face', while water-soaked edges are not. Additionally, a neural network might be used to reflect the statistical insights that underlie such inductive programs. This is an example of a general concept mentioned in Chapter 5 (in relation to musical interpretation) that heuristics originally defined in 'inhuman' logical-sequential programs may be implemented in parallel-processing systems that are more noise-tolerant. For example, a system like this may accurately identify frog eye leaf spot even in the absence of the characteristic yellow halos.

One cannot also argue that the program is meaningless because it addresses a topic that is, to the majority of people, utterly boring—namely, soybean illnesses. Chess endgames as an illustration for soybean illnesses. An art historian may have offered suggestions for identifying a work by Michelangelo or an impressionist painting. Epic poetry might have been described by a literary critic. Or a sonata-form musicologist. The ID3 technique is in theory applicable to ideas in any area, much like analogy-programs. Some readers will undoubtedly object to the idea that applicants for the position of creative thinker should develop H-creative ideas rather than just H-creative rules for defining pre-existing concepts. They will claim that "agricultural experts" were previously aware of frog eye leaf spot. Additionally, the inductive program received this class notion free of charge (although, it must be said, it provided a definition of it that was superior to any human's). The really original conceptualizer was the one who first discovered this illness. A completely original idea couldn't be generated by a computer program to every person. Our fictitious objector will be disappointed to learn that some AI systems have already done this. In fact, the ID3 algorithm itself has uncovered helpful patterns of a rather sophisticated sort that were previously unknown to specialists. As we said before, its input-data (relating to the classification of soybean illnesses, for example) often specifies those characteristics that are known to be significant. However, if ID3 is able to determine if an example belongs to a certain class, it may judge the importance of a characteristic by itself.

For instance, an ID3 chess program (where instances of "a win" and "a loss" can be very clearly recognised) utilised input board descriptions that seemed irrelevant to find previously undiscovered winning tactics for chess endgames. Or, more precisely, it utilised board descriptions whose precise significance, if any, was unknown to the human chess master who gave the program with the input. For instance, the chess master surmised that the White King's advantage is important in endgames pitting King and Pawn versus King and Rook. But he was unsure of how. A winning strategy for this specific end-game has yet to be defined by a chess master anywhere, since its complexity (possible search-space) is too large for the human intellect to handle on its own. But with the aid of ID3, the work has been partially completed. This endgame may be won if the Pawn begins on a certain square or can be moved onto that square using a strategy made up of nine rules that are clearly understandable to chess professionals and are arranged according to a search tree. In conclusion, the idea of a winning strategy developed by the computer for this endgame is H-novel, fruitful, practical (for certain individuals), and beautiful. It would have been warmly applauded if it had been thought of by a brilliant chess player [9], [10].

Undoubtedly, a human chess player would have been less 'rational'. He couldn't have known for sure that every scenario had been taken into account. But to consider a possibility does not always entail investigating it, we mentioned that a heuristic might help reduce the size of the search tree to a tolerable level while still guaranteeing that the answer is not overlooked. Such a heuristic is ID3. Human thought is not a rigidly ordered series of choices, although its processing is. This distinction is intriguing and significant. The program's psychological significance is diminished. However, it does not stop a program from seeming innovative (which is the main issue with the second Lovelace question). It would be illogical to disallow a system's foothold in creativity as a result. (Suppose we found unconscious, parallel mental processes the human chess master utilised that were similar to 'logical' heuristics. What then?)

However, the inductive programs that have been described so far seem to be only somewhat innovative. They establish fresh (P-novel) connections that sometimes result in new, beneficial (H-novel) information. The dimensions of that space do not alter, despite the fact that they may rearrange the conceptual space (making it simpler, for example, to find a specific soybean disease). Once they have finished their task, both we and them may be able to better understand the exact significance of leafspot halos or the White King's position on a precipice. However, the human experts were already aware of—or at least suspected—the significance of halos and edges. This is the primary reason why these features were first made available to the programs. Nobody was made to scream, "Halos? What possible relevance do halo effects have here? In other words, the ID3 algorithm is unable to provide significant surprises. We need to be cautious not to lose sight of the main point when we say this. After all, someone presented with the geometric issue with isosceles triangles in Chapter 5 may respond, "Congruence? What possible relevance may congruence have in this situation? However, the geometry-program, which relied on congruence to find a solution, was far less inventive than Pappus of Alexandria and even less inventive than the ID3 method. These do qualify as basic shocks given the way that humans (particularly those who use visuals) think about geometry. However, the geometry program did not, in a sense - surprise on its own.

An ID3-program cannot surprise itself, either. In its own conceptual realm, it is unable to effect a profound shift. This is something that a more inventive program (like some of those suggested later) might be able to achieve, and it would even be able to acknowledge that it had done. 'Publish or die' appears to be the current motto of science. Whether a scientist's work is published in peer-reviewed journals serves as a measure of their H-creativity as well as their employability. According to this standard, machines can presumably be creative. The American Chemistry Society's publication has published some new concepts generated by a biochemistry program, and the program itself, known as meta- DENDRAL - was acknowledged in the paper's title as a "byline." But one need not be an Einstein to write a scientific study. There is just a little amount of dull Kuhnian puzzle-solving necessary. That is the best meta-DENDRAL can do, unfortunately. One of the first expert systems, DENDRAL (and its 'creative' module, meta-DENDRAL), was developed in the middle of the 1960s and has since undergone continuous improvement. It is somewhat based like how people think since it applies inductive concepts that were discovered by scientists' philosophers of science first. However, it also makes use of certain fairly robotic techniques, such a thorough search through a vast array of alternatives. Additionally, its innovation is rigidly constrained to a very narrow field.

The chemical understanding of the program focuses on a specific class of complex organic chemicals, including certain steroids included in contraceptive tablets. It specifically understands how these molecules act when they are dispersed into smaller parts within a mass spectrometer (by an electron beam) As Kekulé already knew how many carbon and hydrogen atoms were present in benzene, so do analytical chemists in the current period typically know how many atoms are present in a particular chemical. They may not be aware of their exact construction, however. In other words, they are familiar with the parts but not the whole. Chemical theory often provides for a wide range of potential structures—often thousands. Therefore, choosing the proper one is not an easy task.

Chemists may often investigate an unknown substance by dismantling it and identifying the numerous components because molecules break at 'weak' spots. DENDRAL is designed to support them in doing this. On the basis of a compound's spectrograph, or record of fragments, it makes assumptions regarding the molecular structure and describes how these theories might be tested. The program also maps every conceivable molecule (of a select few chemical families) for a given set of atoms while taking valency and chemical stability into consideration. It then analyses this map in order to find potentially "interesting" chemicals that scientists could choose to synthesise DENDRAL initially had to depend solely on its programmers to give it the chemistry that governs how molecules break down. To find additional rules for the base-level program to employ, a second module (meta-DENDRAL) was introduced. To put it another way, meta-DENDRAL looks into the universe of chemical data to uncover additional restrictions that change (enlarge) the conceptual space that DENDRAL resides in Meta-DENDRAL searches for new rules by spotting novel patterns in the spectrographs of well-known chemicals and then offers chemically reasonable explanations for them.

For instance, if it learns that certain sorts of molecules break at certain spots, it searches for a smaller structure close to the broken links. If it does, it implies that further molecules with the same sub molecular structure may also break at these locations. Similar to this, it seeks to generalise recently discovered patterns in the movement of atoms inside molecules. Although some of its theories are shown to be incorrect, none are "a tissue of [chemical] fancies"; rather, they are not chemically ridiculous. Up to a certain point, this program is imaginative, even H-creative. It expands the conceptual area by introducing new rules in addition to exploring it (using heuristics and exhaustive search). It creates hunches that human scientists can verify (about "interesting" compounds). As a result, many new, chemically intriguing molecules have been synthesised. For examining numerous families of chemical substances, it has uncovered several previously unknown laws. Even its curriculum vitae lacks a publication. It is restricted to a small area of biochemistry, however. It also depends on very complex ideas that have been integrated into it by knowledgeable chemists, which is why its assumptions are always tenable. It does not provide any insight on how such theories came to be. Where did modern chemistry originate?

Some human artists known for their ingenuity include Georg Stahl, John Dalton, and Johann Glauber. Although other persons also had a part in these discoveries, their names are linked to significant scientific advancements. In the middle of the eighteenth century, Glauber outlined the differences between acids, bases, alkalis, and salts. In the eighteenth century, Stahl contributed to the understanding of how to identify the constituent constituents of a given compound. Dalton (in 1808) demonstrated that all substances (elements and compounds) had a potential for burning, displacing the phlogiston theory of combustion, which he also devised. Compounds are made up of discrete particles rather than a continuous material. Each of these ideas was rather broad (there were no specific chemical subfields covered here). And they became more basic as they went, starting with the qualitative distinctions between various types of matter, moving through componential analytical principles, and ending with atomic theory. Francis Bacon's theories on how to think scientifically had an impact on Glauber, Stahl, and Dalton. Bacon had made suggestions for techniques to derive general rules from empirical evidence as early as the seventeenth century. Several H-creative scientists also worked in the Baconian tradition, including Joseph Black (who developed the law of specific heat), Georg Ohm (who discovered electrical resistance), Willebrord Snell (who originated the law of refraction), Robert Boyle (who discovered the first of the gas laws), and many others. Some of these scientists are remembered for their fundamental discoveries.

This comes as no surprise considering that Bacon and Descartes' works were responsible for the development of contemporary science as we know it. (Reading Joseph Glanville’s The Vanity of Dogmatizing, a pamphlet first written in the earlier form but later revised in the newly-scientific manner, you can see the tremendous effect of this revolution in the study of nature.) Science is data-driven, according to Bacon, and scientific rules are derived from observations made during experiments. In light of the fact that our theories recommend which patterns to search for (and which tests to do), we now understand that science is more than just data-driven. However, Bacon's fundamental point is still valid: scientists do look for patterns in the experimental data. Furthermore, they can only have a very vague idea of what they anticipate to find if the relevant theoretical framework has not yet been developed. In these situations, they do a rather in-depth analysis of the data.

A group of linked computer programs have been developed to simulate data-driven scientific discovery.6 These programs, which were created with the needs of people in mind, include concepts from psychology, the history of research (including meticulous laboratory journals), and the philosophy of science. Herbert Simon, a senior member of the design team, works at a psychology department. He studied under the scientist and philosopher Carl Hempel when he was a young man. Later, he developed several of the fundamental ideas of AI, including search, search space, heuristics, planning, means-end analysis, and production systems (the majority of which are essential to the programs in the suite mentioned below). His groundbreaking research on human problem-solving has provided us with new ideas and several clever psychological tests, some of which were created especially for this project. He also has a Nobel Prize in economics, for completeness. He obviously understands both what academics have said about creativity and what it is like to be creative oneself.

Instead of helping working scientists, the inductive programs he inspired are meant to provide light on the fundamental characteristics of scientific innovation. We'll find that they place more emphasis on the consciously accessible components of scientific reasoning than on the implicit identification of patterns and parallels. They seem to have rediscovered (P-created) a number of significant physics and chemical principles, including as Black's law. They go by the name of - you guessed it! the following: BACON, BLACK, GLAUBER, STAHL, and DALTON. We'll see how important the term "apparently" is in this context. Since these programs were spoon-fed the pertinent questions, even if they independently discovered the solutions. More spectacular and definitely more inventive was what its namesake humans accomplished. For Bacon and company began applying fresh perspectives to the data. Or, to put it another way, they began classifying new properties, particularly mathematical traits, as "data." Later, we'll come back to that issue. Let's have a look at the results of this program suite in the interim.

To infer quantitative rules from empirical data is the goal of the HAT BAcon DoEs. It receives sets of measurements, or integers, each set of which records the values of a certain attribute at various points in time. It looks for mathematical functions that systematically relate the property-values using a range of numerical heuristics. In other words, it is interested in things that are scientifically "interesting" or that are intended to pique curiosity. If the associated measurements are directly or inversely proportional, and if they are, does the equation connecting them include any constants? are the first questions BACON poses. The program proposes a new theoretical idea that is defined in terms of the two sets of measurements if it cannot find a function that directly connects the two sets of measurements. It might then try to find a principle that applies to the just formed phrase.

For instance, BACON may define their product by multiplying the respective values of the two attributes by one another. Maybe the product is a constant or has a regular relationship with a third property? Once again, the program may split one by the third attribute (which may also be a theoretical concept defined in terms of observables) to investigate the relationship between the two data sets. To find a power-law, it may also multiply each value by itself. It can relate the two measurement sets using a number of these numerical heuristics if required. The software recovered many significant scientific principles using just these rather simple criteria. For example, it developed a variation of Ohm's equation for electrical resistance (I = v/(r + L)) and Boyle's law, which relates a gas's pressure to its volume (PV = c). Ohm's law has two constants (specifically, v and r), which makes it more complicated than Boyle's law. BACON questioned if their product (LI) is constant after seeing that the current flowing through a wire diminishes as the wire's length grows. It's not. However, BACON was aware that it is connected to the values of the current itself in a very straightforward (linear) manner. These initial inductive methods allowed BACON to derive Galileo's law of uniform acceleration, which states that the ratio of distance to the square of the time is constant (D/T2 = k). A later version of the program expressed Ohm's law using the more well-known equation, as we shall see. Additionally, it produced Kepler's third law (D 3/P 2), which states that there is a fixed relationship between the cube of an orbiting planet's radius and the square of its period of rotation around the sun.

The program P created Kepler's law twice. The first time, it had to use data that was "doctored" to make the sums come out exactly right because it would have been irredeemably confused by the messiness of real data. But an improved version was later able to cope with real data: the exact same figures used by Isaac Newton, when he checked Kepler's third law. By starting with the most evident patterns, BACON aims to make its life as simple and its science as elegant as feasible. It does not assiduously go through a list of heuristics and choose one to employ. Instead, it takes each one into account "in parallel," giving the most straightforward solution that applies to the specific situation precedence. However, it is a sequential system since no heuristic may be used until the previously selected heuristic has finished its task. The similarity is with a human scientist who experiments repeatedly, always starting with the most straightforward options.

The first iteration of the program's core heuristics was, in order of importance Infer that a term always has that value IF the values of the term are constant. Infer that two numerical terms are always connected linearly (with the same slope and intercept as on the graph) IF the values of the terms produce a straight line when plotted on a graph. If two numerical terms' values rise concurrently, take into account their ratio. Consider their product IF the values of one term rise as the values of the other fall. Only rules that are very near to the data (laws that can be expressed in terms of observables) may be found using these heuristics by BACON. However, BACON is available in five variants, each with heuristics of increasing mathematical strength. These may be used to create theoretical concepts with a less direct relationship to the outcomes of experiments. Later versions of Bacon are capable of exploring, creating, and transforming conceptual environments with varying degrees of depth and complexity. They may use (for example) the slope and intercept mentioned in the second heuristic above to define second-level theoretical notions. They are capable of creating notions that are defined in terms of increasingly lower-level theoretical conceptions. Additionally, they may discover relationships between rules rather than only between facts or theoretical ideas.

More than two sets of measurements may be related by them. They can tolerate incomplete data to a certain extent. They are able to deal with irrelevant information, first looking at all measurable characteristics but subsequently disregarding those that turn out to be irrelevant due to the lack of regular variation. They may propose experiments to generate fresh correlations and new data points with which to proceed. By using one item as the standard, they may also introduce new fundamental units of measurement. They may employ the idea of symmetry, as applied to equations, to assist them in finding invariant patterns in the data (human scientists often select water). The more experienced BACON has made several important scientific discoveries. P-creations. For instance, the ideal gas laws were found in the third version ($PV/t = k$). Even the Kelvin temperature scale was "invented" using the equation by adding a constant of 273 to the Celsius value.

In the fourth iteration, Ohm's concepts of voltage and resistivity were built, and his finding was stated using the well-known formula ($I = v/r$). It followed in Archimedes' footsteps by figuring out the rule of displacement pertaining to density and volume. It imitated Black's discovery that various substances had various specific temperatures (admittedly, it was given the suggestion that items might be submerged in known amounts of liquid, and the resultant volume could be measured). The quantity of heat needed to increase one gramme of a substance's temperature from 0°C to 1°C is known as its specific heat. At a strictly descriptive level, the fourth iteration also developed the ideas of atomic and molecule weight. In other words, it searched for tiny integer ratios between the combined weights and volumes of chemical compounds and often selected atomic and molecular weights that were consistent with our knowledge of the proper proportions. It didn't attempt to explain these statistics, however (in terms of, say, minuscule individual particles). The fifth iteration of BACON has an equation-applicable symmetry-heuristic that it utilised to discover Snell's law of refraction. Additionally, it generated a more inclusive form of Black's law than BACON-4. The programmers suggested an additional heuristic, which would enable the program to come up with the more familiar equation and which could simplify many other equations as well (more precisely, BACON defines the reciprocal of specific heat; consequently, its equation was inelegant, despite being mathematically equivalent to Black's law).

However, Black did not get his rule of specific heat only from experimental data. He was theory-driven in addition to data-driven. That is to say, he was influenced in part by a gut feeling that the amount of heat would be preserved. The amount of heat is distinct from the temperature. In fact, this distinction—which is a specific example of the division between widespread and intense properties—was clarified by Black's theory. In contrast to intense qualities, extensive properties may be combined. When you add one gramme of water to 100 grammes of mass, you obtain 101 grammes. Temperature is intense; adding boiling water to frozen water will not produce 101-degree water. Since they stipulate that the overall amount of anything stays constant during the experiment, all conservation principles apply to extended properties. A scientific discovery program ought to be able to find all of the conservation rules that apply to science. Accordingly, Simon's team created a new program. Because it discovers quantitative rules that unite numerical data, it may be seen as an extension of BACON (and may even be included as a distinct module). But in order to distinguish it from BACON and indicate that it is more theory-driven, the programmers gave it a different name (BLACK).

BLACK examines instances when two items come together to generate a third (for instance, mixing hot and cold water). It uses heuristics that discriminate between extended and intense qualities in doing so as well as in defining new theoretical words. BLACK has no job to perform if the measurements reveal that all of the observable qualities are widespread and cumulative. However, if the data indicate that a certain property, like temperature, is not extensive, the program attempts to identify conservation rules that would take into consideration these non-additive facts in terms of a newly defined extensive property. BLACK developed a (third) formulation of the law of specific heat in this manner. To describe the outcomes of the experiment, BACON had P-created a theoretical phrase called the reciprocal of specific heat. However, BLACK's interpretation of Black's rule makes sense of the facts by speculating that an unobservable feature (heat amount) is preserved.

You could be saying to yourself, "Nature is not just numbers! “You are correct. Not everything of science involves math. Additionally, even when we do have an equation, we want to understand why it is accurate be able to describe it, possibly in terms of a structural model. As a result, Simon and his colleagues have created three more programs, all of which deal with non-quantitative topics. They are really data-driven, much like BACON. But like BLACK, they are given only very broad 'hunches' on what to look for. They specifically address the issues that Glauber, Stahl, and Dalton first laid out. GLAUBER develops qualitative laws, rules that categorise objects based on their observable features and then summarise the data. These characteristics include a substance's flavour and colour as well as how it behaves in a test tube. Because scientists can't always quantify a property they are interested in, qualitative rules are required. In fact, it is common for qualitative rules to be revealed before they can be stated statistically. For instance, when Mendel established quantitative laws of heredity (declaring the average ratios of various features in the offspring), humans already understood that newborns, animals, and plants acquire specific traits from their parents. The difference between acids and bases (bases comprise both alkalis and metals) and between acids and alkalis was clarified by the chemist Glauber. In order to do this, he categorised the experimental findings — some of which came from studies he himself performed — in a conceptually consistent manner. For instance, he learned that every acid responds.

With each alkali, some salt will be formed. GLAUBER employs the branch of logic to carry out the same kind of action. The program applies this logic to facts about the observable characteristics and reactions of chemical compounds, which deals with assertions like "There is a specific substance that has such-and-such properties," or "All the substances in a certain class have such-and-such properties. “For instance, it may be said that common salt is created when hydrochloric acid combines with soda and tastes sour. they observations enable GLAUBER to conclude that there are (at least) three types of substances: acids, alkalis, and salts, and that they regularly interact with one another. Additionally, it may define higher-level classes (like bases) and then propose theories about those classes as well. Similar to Glauber, GLAUBER does not insist on looking into every acid in the world, or even every acid it is aware of, before making the generalisation that "all" acids react with alkalis to generate salts. It does, however, verify that most of the acids it is aware of have been shown to react in this manner in order to test its assumptions. Therefore, it can put up with lacking evidence as humans do. Scientific reasoning (induction) would not be possible if this kind of fuzziness were not possible.

But unlike people, GLAUBER is unable to cope with negative proof, or counterexamples. It also cannot create fresh experiments in an effort to refute its ideas. The logic of the program is unable to differentiate between rejecting and not stating a proposition, which is the cause of this. People recognize this logical difference in large numbers. It is essential to experimental methodology as well as ordinary tactfulness: telling a friend that her new hat is unflattering is not the same as ignoring the subject entirely. In order to address this issue as well as others, GLAUBER is being enhanced. The program's understanding of experimental methodology, however, is far less than ours. In addition to descriptions, scientists strive to provide explanations. The only summary BACON and GLAUBER have is a descriptive one of the information. By speculating on the conservation of fundamental qualities, BLACK dips its toes into the world of explanation. But STAHL and DALTON go farther, with the first of them going in up to their ankles and the other getting up to their shins in water. STAHL breaks down substances into their constituent parts and identifies the components of each compound. Similar to Stahl, it does not specify whether an element is composed of discrete particles or a continuous substance or specify the relative proportions of the various components.

A list of chemical reactions seen in the lab serves as the input to STAHL. Each reaction is explained by stating that the compounds seen to resulted from the reaction between these substances. The result of the program is a list of chemicals that are broken down into their constituent parts. It gains knowledge as it goes because it remembers and applies previously obtained componential analysis to subsequent inputs. This program is not meant to serve as an example of a single scientific epiphany or even of an afternoon's worth of creative labor. Instead, it is intended by the coders to simulate the sometimes contested advancement of knowledge across time. If experimental results are given to STAHL in the chronological order that they were recorded in history, it generates the explanatory hypotheses - occasionally flawed but always tenable - advanced by chemists throughout history, including not only Stahl but also Henry Cavendish, Humphry Davy, Joseph Gay-Lussac, and Antoine Lavoisier [11], [12].

CONCLUSION

The experimental data must be entered into STAHL in the manner that they were first described in order for this to occur. For instance, the program may be informed that the end product of burning charcoal in air is ash, phlogiston, and air. This is how the response was described in early eighteenth-century writing. According to the phlogiston hypothesis, flammable substances emit phlogiston as they burn. Phlogiston was thought to be visible as the fire seen in combustion studies. In or about 1700, Stahl developed the phlogiston hypothesis. Over the course of almost a century, the theory was improved upon and modified in order to fit new experimental findings as they arose. Lavoisier's oxygen hypothesis was not generally accepted until the 1780s (for instance, when it became obvious that many substances grow heavier on burning, phlogiston was pronounced to have negative weight). By employing the experimental data supplied in their historical sequence, STAHL has been able to repeat many phases of this journey across a changing theoretical space. According to Simon's team, human scientists argue for several, sometimes opposing ideas using similar logic. For instance, Stahl and Lavoisier had basically identical modes of thinking; their differences rested in the experimental data they had access to and the theoretical presumptions they began with. As a result, STAHL's programrs make sure that it consistently employs the same heuristics and reasoning techniques.

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CHAPTER 9

CHANCE, CHAOS, RANDOMNESS AND UNPREDICTABILITY

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ABSTRACT:

The four ideas mentioned above often come up in debates regarding that topic. But they are all used both sometimes "for" and occasionally "against" creativity. For each of these, our brains have contradictory intuitions. Chance is said to have played a significant role in many creative endeavors, including Fleming's discovery of penicillin. But sometimes, it kills innovation in its tracks. In order to demonstrate that syphilis and gonorrhea are distinct illnesses, the anatomist John Hunter infected himself with pus from a syphilitic sailor who, by accident, also had gonorrhea. Hunter died horribly, certain that his unconventional theory was incorrect. In Genesis, chaos and creation are contrasted. However, it is also portrayed there (and elsewhere) as the fertile forerunner of creation, the ground where order is planted and grows. Many people believe that randomness and creativity are incompatible. Mozart's composition of minuets would have been as improbable as the rumored group of monkeys with typewriters who wrote Hamlet in the British Museum basement had he composed his dice-music by randomly selecting every note (instead of meticulously constructing sets of alternative bars).

KEYWORDS:

Random, Chaos, Creativity, Quantum, Randomness.

INTRODUCTION

What do chaos, chance, randomness, and unpredictability have to do with creativity? I have suggested that limits, which are the reverse of randomness, enable creative thought. However, a lot of individuals believe that innovation is all about being unpredictable. How are these opinions reconcilable? We must keep in mind the difference between historical and psychological creativity. The first idea—that H-creativity is a particular case—is more basic. In fact, many P-creative concepts are predictable. For instance, while discussing the necklace game, individuals often notice certain structural aspects and ask specific investigative questions. No less psychologically intriguing since it can be predicted is someone's realization that one might create "a long necklace" or that subtraction-by-necklace would necessitate new rules. It is less interesting historically, however. Since an H-creative concept is one that (again, so far as is known) no one has ever thought of before, all H-creative ideas are (as far as is known) unpredictable. Another concern is whether H-creative ideas are inherently unexpected.

Randomness did, however, play a role when the dice-music was actually played (computer scientists mockingly refer to this as the "British Museum algorithm" for the methodical production and storage of every conceivable state). Random genetic mutations are also thought to be crucial for the emergence of new species. And a jazz drummer with a neurological condition uses random muscle tics as the starting point for fascinating musical improvisations. Unpredictability is a term that most people strongly associate with creativity. It is often believed that it is difficult to comprehend creativity scientifically since, according to determinist science, creative surprise can never be predicted. However, there are both good and bad relationships between predictability and science. Due to the fact that quantum indeterminism is the basis of contemporary science, it is not entirely determinist. In fact, as we will show, even rigidly predetermined processes with well-known underlying principles may be unexpected [1], [2].

Therefore, our four essential phrases have a twofold meaning: uncertainty makes creativity feasible in certain circumstances but impractical in others. We must define the meanings of this word quartet in order to comprehend the complex relationships between creativity and uncertainty. We must also consider if scientific knowledge always entails predictability. The anti-scientific ardour of the romantic and inspirational perspectives is based on the presumption that it does. A scientific explanation for creativity would not seem so unattainable after all if that presumption was to fail 'cHANcE' CAN MEAN the same thing as randomness sometimes. Thus, we refer to "games of chance," such as those played in Monte Carlo, whose results are determined by a random event, such the roll of a die. We even claim that monkeys at the British Museum could not have created Hamlet "by chance" if they had just been pecking away on typewriters. However, in debates on creativity, "chance" often refers to either serendipity or coincidence or mere pity [3], [4].

Finding something worthwhile without actively seeking it is known as serendipity. A prime example is Fleming's discovery, which was a fortunate accident. If the agar-jelly dish hadn't been exposed, either if the window had not been open or the user had remembered to cover the container, the penicillium spores would never have landed on the nutrient, and Fleming would no longer be remembered. It was a messy lab that gave rise to modern antibiotics! Also, coincidence may have been involved. A coincidence is the simultaneous occurrence of two or more unrelated events with separate causal histories when one or more of the occurrences is unlikely and their simultaneous occurrence (which is even more unlikely) causes another important event to occur either directly or indirectly. Fleming's typically conscientious and hitherto celibate jar-coverer may have been rushing to attend an unusual lover's tryst, or a coworker may have unlocked the window to phone a long-lost acquaintance who was passing by. In any scenario, part of what led to his discovery would have been.

Coincidence

Even while coincidence may occasionally be the cause of serendipity, the two are not the same. Because serendipity need not include an incident that is intrinsically improbable. If Fleming's workers had been consistently messy, uniformly addicted to fresh air, and if he had made it a daily ritual to examine the lab benches and window sills, there wouldn't have been any coincidence in his seminal discovery. Similarly, it would have been serendipity rather than chance if Kekulé's broad capacity to alter two-dimensional structures just so happened to result in a closed curve [5], [6].

DISCUSSION

What about the madeleine Proust consumed that caused the flood of memories detailed in A La Recherche du Temps Perdu? This was fortuitous rather than coincidence, given Proust's sweet taste and the popularity of these treats among French bakeries. The same may be said about Coleridge's reading of "Cublai Can," which helped shape his conception of Xanadu. Coleridge may or may not have been coincidentally reading about the "burnished gloss" of marine creatures when he created his vision of the water snakes. There is evidence that he had in mind the missing Bounty mutineer Fletcher Christian, who had attended school with Wordsworth, when he had long intended to compose a poem about an elderly sailor. He read and reread several texts concerning sea trips and marine life in accordance with them, making notes about some of them in his notebooks, as we have seen. If, during this deliberate literary search, he came upon the word "burnished gloss," his discovery was not accidental. It was if he happened to come upon it while reading something for a completely other purpose. Since the term appears in Captain Cook's memoirs, it is very unlikely that serendipity is the cause of his discovery.

For instance, computational procedures like those described enable serendipity. There, we saw how 'spontaneous' pattern completion and analogous pattern matching may occur how the system is not set up to watch out for a minor regularity, but it may still detect it. 'Low-level' associative memory is not the sole source of serendipity, however. In general, activities and abilities that may operate in parallel, particularly those defined in terms of high-level structural limitations, may interact in unexpected and unanticipated ways. Human brains are ideally equipped for having spontaneous thoughts since they may process information in several types of parallel. Determining if a creative thought came to you "by chance," as in by accident, is not always simple. On the one hand, a true coincidence can be mistakenly interpreted to be the result of a common cause, as if someone had a superstitious belief that Terpsichore, the muse, set up John Lennon and Paul McCartney's attendance at the same Liverpool school. However, if the co-occurring events are significant enough, what we first perceive to be a coincidence may not really [7], [8].

Events really have some essential causal historical similarities. For example, Hunter's unfortunate destiny was caused by an unforeseen accident rather than chance since the two venereal illnesses in issue had a very similar causal history. (In fact, it was because most persons who had one condition also had the other as a consequence of identical behaviours that the traditional view that they constituted one disease had developed.) What about Darwin and Wallace developing evolutionary theory almost simultaneously? This seems less like a coincidence when one considers that naturalists of the middle of the nineteenth century frequently accepted the theory of evolution, that the question of how it worked was still open, and that many educated people (not just these two) would have read Thomas Malthus's work on the winnowing of populations due to pressures on the food supply, simultaneous discoveries often owe considerably less to coincidence than is commonly believed. Furthermore, coincidence isn't always a good thing since it may hinder creativity just as much as it can encourage it. The unexpected visit of the gentleman from Porlock to Coleridge's hut was one of the unhappiest incidents in literary history; without the interruption, Kubla Khan would undoubtedly have been lengthier.

Because we cannot forecast the unlikely co-occurrence of causally unrelated occurrences, coincidence is unpredictable (or, in the language to be discussed below, it is R-unpredictable). In terms of serendipity, there is often little chance of finding anything without looking for it specifically. Serendipitous P-creative ideas may very seldom be predicted. For instance, a parent may purposefully leave a new device on the dinner table in the hopes that the youngster would attempt to understand how it works. Let's say that the device was specifically picked to demonstrate a concept from the child's unfinished physics homework. The parent can say with some degree of certainty that tonight's homework session will go more smoothly than it did yesterday. However, from the viewpoint of the youngster, its P-creation of the relevant physical principle (at supper, rather than during schoolwork) was founded on serendipity.

So, in actuality, serendipity and coincidence are both unexpected. Thus, the innumerable original thoughts that have these two sources to thank are also in a sense unexpected. The influence of chance in many instances of creativity means that individuals who seek a scientific knowledge of creation will unavoidably be let down if science must be predictive. But if (as will be demonstrated later) it need not be, serendipity and coincidence's surprise-value pose no danger to it. Even though the genesis of novel ideas is often influenced by chance, creativity cannot be attributed to randomness alone. In earlier chapters, we looked at a number of instances from both the arts and sciences that demonstrate the importance of structural restrictions and specialised expertise. In other words, Fleming wasn't just fortunate. Fleming's knowledge of bacteriology gave him the insight necessary to understand the significance of the clear (bacteria-free) spaces around the greenish colonies of mould, as well as giving him the first awareness of them. Fortune rewards the prepared mind, as his great forerunner Louis Pasteur once said. In the definitions of serendipity and coincidence given above, the adjectives "valuable" and "significant" really imply some kind of judgement on the part of the creator. Whereas other people would have seen the contaminated dish as nothing more than dirt to be thrown away, Fleming was able to regard it as significant. While chance alone cannot produce creativity, chance combined with judgement may.

How about chaos? There are two common interpretations for this term, one of which being complete disarray or chaos. Chaos is the opponent of creativity in this sense because it lacks the crucial component of ordered judgement required to comply with the relevant high-level creative limitations. The second definition, which is the first one in my dictionary, is related to the book of Genesis and refers to "the shape of matter before it was reduced to order. In this view, chaos—while still being opposed to creation—is understood as its forerunner. We may leave it up to theologians to decide if chaos is a necessary precursor to God's creation. However, it could be a necessary need for certain creations that are credited to people rather than to gods. The teeming anarchy of the Note Book provides us the charged and electrical atmospheric backdrop of a poet's thoughts,' said Livingston Lowes. He contends that each verse was crafted from the tumultuous material created by Coleridge's catholic reading by describing the flowering, buzzing, confusion it caused. For example, Coleridge's mind and the Mariner's sea both include water snakes that twist, twirl, and jump out of the depths, as we've already seen. It's true that moving from chaos to creation calls for the guiding hand of judgement, or what Coleridge termed the poetic imagination. However, a raging disorder, a jumble of components taken from wildly different sources, might result in stanzas as clear as this I saw the water snakes outside the ship's shadow: When they reared, the elfish light fell off in gloomy flakes. They travelled in trails of brilliant white.

Think about the pipeline-program described at the conclusion of Chapter 8 when you want an example of a computational paradigm where order emerges from chaos. It begins with a chaotic (produced at random) collection of IF-THEN rules and using genetic algorithms to create a new set of extremely effective rules. The word "chaos" also refers to a less well-known subject of mathematics called chaos theory. Chaos theory analyses complex systems that are (at a given level of description) deterministic yet in practise unpredictable, with applications ranging from weather forecasting to studies of the heartbeat. The chaos theory has discovered certain previously unrecognised regularities at different levels of description. Later, while addressing uncertainty and science, we'll return to it. Three things may be interpreted as "RANDoMNEss." We need to disput an end to these three perceptions since they each have a unique impact on determinism, which many people believe is incompatible with creativity.

The first two interpretations are very connected. A-randomness, often known as "absolute" randomness, is the complete lack of any structure or order inside the domain in question, whether it be a group of occurrences or a collection of numbers. 'Explanatory' randomness (E-randomness) is the complete absence, in theory, of any explanation or reason (it is famously difficult to define A-randomness properly, but for our purposes this intuitive definition will serve. E-randomness is technically the more significant concept from our perspective since our specific focus is in whether creativity can be scientifically explained.

However, if a circumstance is A-random, it must also be E-random. It follows that it is sometimes useless to distinguish between them, thus I will use the term "A/E-randomness" to encompass both (because explanation is itself a sort of order, A-randomness entails E-randomness).

However, there are times when the difference has to be stated clearly. Imagine, for instance, that a lengthy sequence of coin tosses always results in alternating "heads" and "tails." Although this coin-tossing sequence is very implausible, it is plausible. The series is not A-random since there is order there, but there is no discernible reason for the way it is organised. To be sure, there are (physical) reasons for every single coin-fall. However, the string of 'heads' and 'tails' in alternating order does not. In other words, E-randomness exists here but not A-randomness. (This example demonstrates how it might be important to pick the level of description at which we seek for randomness; we'll remember this idea later on when we discuss quantum physics.)

Lack of any structure or order that is pertinent to a particular topic is referred to as "relative" randomness (R-randomness). You probably already know all too well that poker dice, for instance, roll and fall R-randomly regardless of the players' knowledge or preferences. In terms of the wallpaper design, they likewise fall R-randomly, although no one would care to mention this. In reality, R-randomness is always determined by reference to a possible relevant example (would the poker dice cooperate if you close your eyes and mutter "Six, six, six"?). The potentially important "something" is often the creator's own knowledge, the framework of conceptual restrictions into which the original thought may be fitted, in debates about randomness and human creativity [9], [10].

An event must be R-random with regard to all factors if it is A/E-random. However, a strictly confined (and even predictable) event that is R-random need not also be A/E-random since it might be rigorously limited (and even predictable) in terms other than the one in which it is R-random. For instance, poker dice are governed by the laws of gravity (which is why a shady casino allows players to be "loaded"). The progressive accumulation of neurotransmitter chemicals at the synapses is what causes the random firing of neurones described in Chapter 6. Additionally, an involuntary musculature tic may be caused by recognisable chemical processes localised at the nerve-muscle junction, processes that are not influenced by brain signals and hence are not within the control of the individual or their free will. R-randomness does not imply indeterminism, but A/E-randomness does.

It is debatable if all three forms of randomness genuinely take place. No one disputes the existence of R-randomness; even determinists acknowledge that it exists. According to quantum physicists, certain occurrences are A/E-random (as we will see when talking about unpredictability below). But according to rigorous determinists, A/E-randomness is like the unicorn: a fascinating idea that has no application to anything in the actual reality. The many meanings of "randomness" are not easily distinguished between randomness that is anti-creative and creative. Think about genetic mutations, for instance. Because they are brought on by chemicals that affect a gene in accordance with established biochemical rules, certain mutations of single genes are unquestionably not A/E-random. Some people could be A/E-random. If each individual X-ray's emission is A/E-random, as suggested by quantum physics, then X-ray-induced mutations must also be in part A/E-random. Otherwise, they could be completely deterministic.

Which of these is accurate is irrelevant to evolutionary biologists, who are focused on the inventive potential of genetic changes. For their goals, it is crucial that the mutations be R-random in terms of their capacity for adaptation. In other words, a mutation does not occur because it has a high chance of surviving, but rather because of another factor, which may or may not be A/E-random. R-randomness plays a crucial role in how organisms evolve. Natural selection may be counted on to pick out the undesirable mutations due to the biologically unconstrained mutations' wide variety, which makes it probable that some will have survival value. In fact, certain bacteria have the ability to accelerate the pace of some (non-specific) forms of mutation when exposed to potentially deadly conditions; as a consequence, they may be able to utilise a new food source that they were previously unable to use.

Certain chromosomal modifications (as opposed to changes in a single gene) may not be totally R-random in terms of their survival value. As we observed in Chapter 8, biological 'heuristics' like crossover provide constraints-for-adaptiveness, causing physiologically plausible alterations to occur more often than they otherwise would. However, even these mechanisms cause R-random breaks in the chromosomes. R-random processes of genetic change would only be unnecessary for evolution if (which is practically impossible) these "Lamarckian" limitations could ensure the occurrence of highly adapted changes. Similar arguments may be made for human creativity, up to a degree. No one can promise that a computer programme, advertising copywriter, physicist, poet, or other creative person will always come up with a good idea. It's true that certain individuals are often able to come up with P-creative ideas, while a select few—such as Shakespeare and Mozart—are consistently H-creative. As we have shown, such consistency requires the methodical investigation of highly organised conceptual spaces and cannot be critically dependent on chance occurrences. But even Shakespeare and Mozart, who were able to use accidental inspiration more effectively than nearly anybody else, were probably not opposed to it. A mental or environmental coin flip is as excellent a means to decide as any when faced with creative limits (such as laws of metre and harmony), which may leave numerous possibilities available at particular moments in one's thinking. This may play a role in how one artist develops their own style. When the general art form, such as sonnets, Impressionism, or garment design, offers a variety of options, someone could have a very consistent and unique style of choosing what to accomplish.

In other words, ‘mental mutations' often enhance human ingenuity. Random events like chance, serendipity, and loose mental association—what advertising and management consultants refer to as "brain-storming"—are helpful because they provide fresh ideas that may be incorporated into a formal creative process. Even neurological disorders may contribute to this. For instance, the jazz drummer's coincidental tics are very probably not A/E-random, but they are R-random with regard to music. They provide unexpected rhythmic concepts that conscious intellect (and Languet-Higgins' metrical principles) could never have developed, but which musical competence can recognise and exploit. This is where their strength rests.

It's essential to have mastery, which calls for both intentional judgement and associative memory. It gives us the ability to benefit from unpredictability, to recognise and enhance its importance, just as natural selection does in nature. Throwing dice may have given Mozart some inspiration for a symphony, but he would have judged their musical significance. If the monkeys from the British Museum ever produced the phrase "To be or not to be," they would not even be able to recognise it as a sentence, much less as a question. Mastery also broadens one's mental environment since a well-stocked associative memory offers more 'ecological niches' for new combinations to flourish and more opportunity for new ideas to connect. This is a reason why experience and the desire to gain it are crucial components of creativity. What helps with human creativity and evolution also helps with creative computers. A computer model of creativity that can be believed in would need to be capable of random transformations and/or associations. Its randomising processes might be A-random; for instance, its associations or instructions could sometimes be generated using lists of random integers. They are not necessary, however; R-randomness will suffice. In fact, evolutionary algorithms may create order out of chaos, and certain innovative programmes (like Cohen's and Johnson-Laird's) depend on random numbers at specific times. Additionally, some computer models engage in rather unrestricted analogy hunting in their "spare" time. This computerised R-randomness may coexist with more systematic (and perhaps more reliable) 'rules' for coming up with creative solutions, such as the inductive heuristics of the BACON family.

In theory, a clever computer might use systematic brute search to discover chance (R-random) ideas. The machine could thoroughly test all conceivable combinations of its ideas every time it tried to be creative if it were quick enough and had a large enough memory. But given a data base of any magnitude, the time needed would be obviously enormous. Acrobats with just one arm, which AARON would find impossible, as well as acrobats with six arms, like a Hindu deity, would ultimately appear to the brute-force computer. However, acrobats with pencil boxes for feet and a cabbage for a head would also do so. What's incorrect with that? A history of art would wonder why Giuseppe Archimbaldo portrayed human features as collections of fruits and vegetables in the fifteenth century and René Magritte was the inspiration for a surrealist portrait of a bourgeoisie with a cabbage for a head in 1936. Undoubtedly, cabbage heads are within the realm of imagination. However, how about a cabbage head with pencil-box feet and a Taj Mahal rib cage (a really unique concept)?

Our fictitious brute-search machine would require enough intelligence to understand that although cabbages, pencil-boxes, and castles may all coexist together in art, only carrots and cabbages cannot. A creative computational system must be able to locate the original notion into a conceptual space bounded by comprehensible restrictions (if it does manage to persuade itself - and us - that the final three things may make sense within some newly-developed style, fair enough). It must be able to distinguish between innovative combinations of concepts that are more and less attractive. In other words, intelligence must oversee brute-force search if anything innovative is to be produced. Unpredictability, the fourth member of our conceptual quartet, is the most crucial since it seems to many people to science will no longer be able to understand creativity. Unquestionably, creativity has a surprising worth. Indeed, as we saw, it is a crucial component of the idea. It is absolutely improbable that a contemporary could have foretold Beethoven's next sonata. Even the Saatchis' next commercial or (often) Grandpa's next quip are impossible to foresee. It would be absurd to attempt to predict what concepts a creative person would come up with over the long term, like in three years. Yet why? What kind of unpredictable behaviour is this? And does it actually end any chance of scientifically understanding creativity?

Since nothing is governed by any rules or determining circumstances, anything that is unexpected in the strictest sense is completely unpredictable (also known as "A-unpredictable"). In other words, A-unpredictability entails indeterminacy, much as A-randomness. It is debatable if any occurrences are really A-unpredictable. There are, according to quantum physics. According to quantum physics, some physical occurrences, such an electron 'jumping' from one energy level to another, are unforeseeable because they are uncaused at that level of description. Without any rhyme or reason, the electron moves this way rather than that. Each individual electron-jump in the language discussed above is A/E-random (there is no rhyme or reason to it). Quantum physics asserts, however, that many classes of ostensibly A-random occurrences are really predictable and neither A-random nor E-random. These vast groups of subatomic occurrences exhibit order in the form of statistical regularities, indicating that they are not A-random. Due to the possibility that these regularities may not be E-random, they described by the quantum physics wave equations. These equations also allow the physicist to precisely forecast how the relevant physical systems will behave over the long run (i.e., their statistical distributions). Some claim that quantum physics must be false or inadequate because, in the words of Albert Einstein, "God does not play dice." In response, quantum physicists may concede that quantum theory could be incorrect, but they maintain that only an illogical bias in support of determinism would lead anybody to believe such. They won't, however, acknowledge that it could be imperfect in the sense that determinists want. They present a mathematical demonstration that shows it is impossible to expand quantum theory by introducing hidden variables that follow non-statistical principles since doing so would require specific changes to experimental predictions. In other words, if quantum theory is true, then the A-unpredictability of quantal events is truly absolute [11], [12].

CONCLUSION

Whether quantum physics is correct or incorrect is irrelevant to us. Granted, it's possible that quantum effects in the brain cause some of the seemingly random thoughts to come to mind. If true, then individual quantum leaps that are A-unpredictable may theoretically contribute to creativity (just as other R-random occurrences might). However, creativity is not any more 'beyond science' as a result of this than X-rays are. In summary, quantum physics shows how unpredictability, even A-unpredictability, is not incompatible with science. For our consideration, the second meaning of "unpredictability" is more crucial. In reality, an occurrence may be unexpected in the sense that neither actual people nor other finite systems, such as computers, can forecast it. Let's refer to this interpretation of the word as "R-unpredictability" since it is defined in relation to the predictor. Any event that is A-unpredictable must logically also be R-unpredictable, given all predictions are respected.) There are many levels of R-unpredictability, as gamblers are aware. When something cannot be predicted with confidence, it does not follow that there is a 50/50 probability that it will occur. specific conditions may be significantly more favourable for specific occurrences than other conditions. When the chances are either extraordinarily high or extremely low. In practise, theoretical R-unpredictability may be disregarded. For instance, according to thermodynamics, a snowball might exist everywhere. But it would be exceedingly silly of anybody to search for snowballs in the Sahara.

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CHAPTER 10

AN OVERVIEW ON ELITE OR EVERYMAN

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ABSTRACT:

The historically creative are seen as being separated from the rest of mankind by 'theories' of inspiration and romantic city: H-creative insights, and people who are H-creative are thought to be intrinsically unique. It is said that H-creators have a specific ability that allows them to generate their ideas, in addition to receiving supernatural support. Both of these mythical strategies use individual reports of one's own H-creativity as proof. Great scientists and artists have repeatedly recounted having ideas suddenly occur to them. What was reportedly sudden, though, could not have really been sudden. And there may be more awareness involved than one realises in what seems to have no conscious explanation. Think about the common occurrence of observing something, for example. The two concepts of noticing and noting how you observe are extremely unlike. Consider the last time you saw something, or keep an eye out for it the next time, and attempt to list as many pertinent details about your own thinking (both conscious and unconscious) as you can. You could struggle greatly with this. If that's the case, your routine accomplishment of noticing could start to look almost strange.

KEYWORDS:

Creative, Elite, Even, Everyman, Insight.

INTRODUCTION

Mozart, though, was unique.' He was, in fact. And winning the cost of a hot supper is different from winning a million pounds in football pools. The life that a fortune enables is substantially different in ambition, diversity, and freedom, rather than merely more of the same (cooked meals every day). The pool winner must learn new talents and explore uncharted conceptual waters. Learning to sail a boat or understanding the just hung Picasso in the living room will need some effort. Even the chance to donate enormous quantities of money to charity comes with its own set of challenges, issues that could never have existed previously. However, the pool winner doesn't require any exceptional abilities—native wit would suffice. Does Mozart possess a particular romantic ability or supernatural influence that sets him apart from the rest of us? Or maybe it's more akin to the difference between earning a fortune and winning a meal ticket, the former of which creates a space of chances and challenges while the latter does not? Could Mozart's unique skill in using the human mind—a computational resource we all share have contributed to his genius?

'Insight' is just as enigmatic.

Similarly, you won't always be able to describe exactly what it was that reminded you of anything or to explain the gaps between the first and final thoughts. Your struggle isn't entirely a result of how covert the unconscious forces at play are. Because even conscious ideas themselves may be elusive, and even honest descriptions of them aren't necessarily trustworthy. For instance, attempt to recall all the ideas that cross your mind when you compose the line(s) of a limerick that begins, "There was a young lady of Brighton. It is likely that you will get a meagre crop. Trying to capture one's thoughts as they are happening and record every fleeting picture is difficult. This is one reason why the idea of intuition or inspiration is so alluring (of course, one does not even attempt). People seldom ever attempt to record the specifics of their conscious thought, and even when they do, they often fall short [1], [2].

They haven't learned how to introspect in a manner that is likely to provide insightful outcomes, which contributes to their lack of success with introspection. Simply asking someone to "think aloud" may not pique their attention. However, it could be helpful if you instruct them on how to proceed. The psychologist Perkins offers six "principles" of introspection in his intriguing exploration of creativity: Express yourself whatever you choose. Don't be afraid to act on your crazy ideas, intents, or hunches. Continue talking as much as you can. Use your voice at least once every day even if it's just "I'm drawing a blank," five seconds. Use clear voice. As you become interested, be aware of your voice quitting. Use as much telegraphic language as you choose. Don't stress about using whole phrases or being eloquent. Avoid over-explaining or justifying. Don't analyse more than you typically would. Don't go into detail about the past. Make it a habit to express your ideas as they occur, rather than contemplating for a while before explaining them [3], [4].

Try it! (This time, you may finish: 'There was a young man of Tralee...') You'll probably discover (particularly if you repeat the practise often) that you report having a lot more on your mind than you did during the prior introspective exercise. In other words, a variety of fleeting conscious ideas are also engaged, notwithstanding the significance of unconscious processes. The infrequent reporting of them is not conclusive. Another factor contributes to the reliability of introspective accounts of creative thinking. Self-reports are influenced by an individual's covert assumptions or preconceptions about the function of "intuition" in creativity. Introspection means examining one's own thoughts, and it has a similar significance to one characteristic of peering into anything else is that, for the most part, you see what you anticipate seeing. When presented with a case of smallpox during an outbreak of chicken pox, a doctor is extremely prone to misdiagnose the condition. In fact, there are a lot more shocking instances of perception bias [5], [6].

In one study, a picture of a baby resting against a brick wall wearing a white gown with a plain neck frill was shown to medical students. Numerous diagnoses were provided by the pupils. They noted that because the infant was resting well, several ailments might be ruled out. They disagreed over the seeming carelessness implied by the pristine flowery nightdress, as opposed to the apparent care represented by the infant being placed up against hard bricks. No one correctly understood the situation. The infant was really dead, not sick or sleepy. The nightdress was really a hospital shroud, which the medical students were familiar with. The brick wall was the hospital mortuary wall, which they had seen many times before. Despite the obvious irregularities in the circumstance, their implicit expectation that they would be given a live baby rather than a dead one caused them to mistake even familiar facts.

A fleeting self-perception may be contaminated by expectations about what one will or will not find, which is much more probable if many very bright individuals debate an image in front of them for twenty minutes. In your own introspective experience, "insights" are likely to seem to arrive quickly and unannounced by prior awareness if you already hold this belief. And you won't be searching as diligently for reasons that may be susceptible to awareness if you already think that they are brought on by some unconsciously occurring (and perhaps semi-magical?) process of 'intuition'. Livingston Lowes delved so deeply into Coleridge's library, using the notebooks as his guide, precisely because he did not believe that Coleridge's poetry was produced by supernatural means (likewise, someone trying to explain someone else's thought-processes will look rather harder if convinced that there is something "concrete" there to find). Furthermore, someone who embraces the romantic concept that H-creative people are somehow separated apart from the rest of us and who aspires to be considered as H-creative would not want to find too much conscious richness in their thinking. And one does not search rigorously for something one does not wish to find.

DISCUSSION

Introspective reports of creative experiences cannot be accepted at face value for all of these reasons. Even if they are complete and accurate accounts of the person's conscious experience, which may not be the case, they are nevertheless shaped by assumptions in a similar way to how 'outside' perception is. The same warnings apply to memory. According to psychological studies, people's recollections of specific events are greatly influenced by their general beliefs and the conceptual frameworks that serve as their mental maps. In general, only things that fit into one's conceptual spaces may be kept there; things that don't fit are' squeezed' into (or rather, out of) form until they do. This further calls into question the veracity of 'introspective' claims of creative insight, given the majority of them are really retrospectives. Artists and scientists are often far more preoccupied with the product of their labour than they are with the process of creation. Furthermore, the significance of the concept is often not completely understood until much later. The author doesn't start writing down the (claimed) specifics of what really happened until that point, possibly encouraged by an adoring audience. Therefore, the narrative of what happened has an increased chance of being influenced by the creator's preexisting notions about the creative process [7], [8].

For instance, there are contradictions in Coleridge's well-known narrative of how he came to write Kubla Khan, which he entitled "A Vision in a Dream." both with other accounts of this occurrence made by the individual and with supporting documentation. The most well-known story is found in his Preface to the poem, which was released in 1816. There, Coleridge claims that he "fell asleep" in 1797 (exactly 20 years earlier) and stayed in "a profound sleep, at least of the external senses" for a few hours. However, in 1934, a manuscript written by Coleridge was found, and it had a slightly different version of the poem, referring to "a sort of Reverie" rather than a "dream" or "sleep." Internal evidence shows that this (undated) version predates the poem as it was published since some of the ways in which it differs from the popular form are more in line with the texts, such Purchas's Pilgrimage, that are known to have influenced his production.

In examining this issue, Perkins notes that, in addition to being (as are all of us) a prisoner of his own memories and conceptions of the creative process, Coleridge was not too meticulous about getting his verifiable facts correct. His own colleagues thought he was unreliable when it came to dates of composition (the difference was sometimes by much more than a year or two). Additionally, a number of instances when his 'factual' findings cannot be believed have been cited by literary historians. Therefore, Coleridge was neither a rogue nor an idiot. He was just a human being with constraints imposed by human memory (as well as the allure of sloth). This is a broad concept that doesn't only apply to Coleridge. Written accounts of events that occurred years ago are fascinating and may be used as proof. But they cannot be considered absolute. Poincaré's theory, which is largely accepted among authors on creativity, holds that incubation—time away from the issue—involves a specific kind of lengthy unconscious thought. However, this theory cannot be regarded as gospel. To be sure, Perkins' many experiments to this effect suggest that his insistence that it entails more than simply a restorative break are accurate. However, there are additional reasons why a shift in activity might be followed by a breakthrough idea that exists

For instance, one may have a consuming topic on their mind often during the day, possibly when combing their hair or doing the dishes. According to Perkins, "time away from the desk" does not always mean "time away from the problem." Or maybe you are about to solve an issue when there is a disruption. When you come back to the issue after some time has passed, the answer that was just about to hit you previously could suddenly show itself. This may be explained by memory, instead of any 'incubatory' thought. Alternately, during the time spent away from the issue, one could have picked up a hint, either consciously or unintentionally. This is not "incubation"; this is serendipity (noticing). Once again, sleep gives you time to stop thinking about the issue consciously. Additionally, it seems to allow for some relaxation of the logical restrictions that are seen in the waking state (thus the many instances of people experiencing creative thoughts when they awaken). Last but not least, the belief that a course of action in which one has already spent a large lot of effort must be the best course of action may prevent a solution. However, if one focuses about other things and puts aside worries about how to address the issue for a bit, this sensation may be diminished. It seems sense, therefore, that switching one's focus to another (perhaps similarly challenging) subject sometimes aids in one's mastery of the first. None of this, according to Perkins, disproves the existence of certain kinds of incubatory thinking. However, there is no concrete proof that it does. And there is a tonne of data to back up a number of alternate explanations for why putting off an issue may often be beneficial. In conclusion, there is little evidence to support the notion that creativity comprises unconscious cognition that is fundamentally distinct from conscious thought [9], [10].

Our everyday talents are crucially reliant on creativity observing, recalling, seeing, hearing, speaking, and comprehending language and making analogies: All of these Everyman skills are significant. In order to change our current procedural abilities in different ways, we need to be able to redisplay them on higher levels of representation. As we have seen, this gives young toddlers the ability to create more inventive "funny houses" and "funny men," and it doesn't get much more commonplace than that. However, calling something commonplace does not equate to calling it easy. Take Kekulé's vision of the snakes as an example. We took a lot for granted when we spoke about Kekulé's accounts of his experiences by the fire and on the omnibus. We questioned how he came up with the comparison of molecules to snakes, but we did not question how he came up with the idea of snakes in the first place. We assumed Kekulé, like the rest of us, could see snakes as having particular spatial shapes and that he could discern when one had grabbed "its own tail." We also assumed that he could discriminate between "groups" of atoms and recognise "long rows" or "chains." He could see certain atoms as "smaller" and others as 'larger'. We also didn't challenge his perception of atoms "in motion" or snakes "twining and twisting."

How is it feasible to obtain these results? They are mental accomplishments, after all. Their dependency on the mind is not because Kekulé's snakes and his gambolling atoms were made up; a camera cannot perform any of these things. Similar concerns are raised about actually seeing snakes. Imagine Kekulé had been walking in the field when he had seen a snake that chewed its tail. We may still inquire, for instance, as to how he determined that the snake's tail was its "own" tail. Similar to how resemblance is a mental construct, so is visual shape. Introspection gives the impression that visual form perception is easy and quick. We 'simply see' snakes, snails, and snowmen, it seems. These introspections, however, are deceiving since even such commonplace sight is not psychologically straightforward. On the contrary, it requires some sophisticated computational manoeuvres. Kekulé needed to be able to identify individual figures as separate from their surroundings in order to perceive and picture snakes. In order to distinguish lines from spots, he had to determine their continuity and end points. He had to understand juxtaposition and distance if he was to discern "groups" of atoms, lengthy rows that were "more closely fitted together," or a bigger atom that was "embracing" two smaller ones (a snake biting its own tail has all continuity and no end-points). He had to make relative size judgements in order to see a row as "long" or an atom as "larger" or "smaller."

The underlying interpretive processes are neither evident nor straightforward. Even locating the 'lines' is challenging. Take a look at a picture of someone wearing a black-and-white striped tie (or a retinal image of that person). You could believe it is simple to recognise the margins of the stripes. You may respond, "Surely, each edge is a continuous series of points at which the light intensity changes abruptly: bright on one side, dark on the other." Therefore, all that is required is a small physical light-meter that can crawl over the picture and identify those places. Yes and no, I suppose. In fact, the eye and many computers already have the physical sensors required to detect abrupt changes in light intensity. The issue is that there is seldom a continuous succession of change-points in the picture that perfectly fits what we understand to be a line in reality. In general, the physical picture reflected off an edge of a physical item (like a snake) or of a marking on a physical surface (like a stripe) does not correspond to any distinct, continuous sequence of changes in light-intensity. There will be short segments of continuous intensity shift in the picture, but there will also be pauses and off-shoots.

While the offshoots are not colinear throughout the gaps, significant parts are. Not just physics, but also computing, are necessary. The line-finding gadget could need some assistance from depth detectors if the viewer is staring at a dalmation puppy that is curled up on a zebra-skin rug. A single black area in the picture may be a black zebra-stripe next to a black dog-patch. There may not be a difference between the ruggy and the doggie portions of the picture area in this case with regard to physical light intensity. If there are similar issues with other dog-and-rug sections in the picture, simple colinearity (with the lines indicating the neighbouring contours of the dog's back) may not be enough to solve the issue. However, depth detectors are useful. Depending on how close an item is to the eyes, the pictures that land on the left and right eyes are somewhat different. Consequently, depth contours where one physical surface is slightly in front of another can be found by systematically comparing matching point photographs. So the visual system can locate the dog's body contour inside the uniformly black area of the picture. And if one of the several line segments running into the dark zone is colinear with that depth contour, then that line segment most likely depicts the dog's back.

The visual system also has texture-detectors that may compare texture differences between neighbouring areas of the picture. These may not be very helpful in the situation of the fuzzy dog resting on the furry carpeting. However, they may assist in clearing up any confusion between the dog-and-lino picture areas if the Dalmatian was sleeping on a black and white lino floor. Kekulé would have required depth, texture, and line detectors in addition to line detectors if he had observed a snake laying on striped grass and twigs. The snake might also be seen with the use of motion detectors since moving picture lines often indicate actual object edges. In other words, it takes sophisticated computing processes to perceive snakes twining and twisting, or biting their own tails (this is why many animals 'freeze' when they feel predators).

Visual interpretation applies to the visual arts as well as to viewing snakes and envisioning benzene rings every day. Consider the detailed line drawings by John Tenniel versus the (far simpler) sketches of acrobats by AARON. Even with smeared newspaper copies, how can the individual lines be distinguished? And which one do you think they are—the biceps of an acrobat's arm or the hem of Alice's dress? Recall the late nineteenth-century Impressionist movement once again. Or think about Picasso's artistic development from the charming Blue and Rose periods, where his paintings were largely realistic, to the proto-Cubism of Les Demoiselles d'Avignon and the intensely analytical Cubism of Girl with a Mandolin, and finally to the distorted portraits of his mistress Dora Maar from the 1930s, where she is depicted as having two eyes on the same side of her nose. These new styles were despised at the time by many art experts as being abnormal, illogical, and (thus?) unattractive. Some continue to. However, a computational psychology may assist us in understanding something that the artists involved instinctively understood (often supported by a reference to the relevant scientific theory at the time). Such painting techniques are based on the intricate patterns of natural perception. With the exception of Narcissus' Pond, there are no instances in nature when humans may simultaneously observe from two points of view. We constantly experience the world from a single perspective since our eyes are located at the front of our heads and we are unable to be in two places or adopt two different physical postures at once. This feature is purposefully taken advantage of in computer vision models, whose interpretive heuristics only function because it is true. Our natural visual calculations presuppose a single perspective, and the biological visual system does the same.

Therefore, it seems sense that we are taken aback when we first meet Dora with what appear to be two eyes on each side of her face. In the actual world, such a thing has never been seen before and cannot be seen. Simply said, our visual system does not allow it. But who said that an artist must submit to all of the realities of life? Enough if he can make use of them, confront them, and modify them in ways that make sense to us. The images of Dora are understandable (and, if one has seen a picture of Dora, even recognisable). After all, she does have two eyes and a nose with a Roman profile. Simply said, we cannot envision her having all three of these things at the same time in real life. Why should we object if the painter decides to show all three on the same canvas? Is he truly acting in a completely bizarre way that has no logical basis in our knowledge or visual experience? Or is he instead investigating the conceptual area that encompasses both frontal and profile views of objects?

Similar to this, what is wrong if a cubist decides to investigate visual form in terms of geometry? Why should Picasso have been forced to keep his Demoiselles, which was rejected even by his closest friends and fans, coiled up in his studio for twenty years? Why was Cézanne's suggestion to a fellow artist to "deal with nature by terms of the cylinder, the sphere, the cone, too"? How realistically a painter may show nature in these ways raises an interesting aesthetic dilemma. Some psychologists have attempted to explain our perception of spatial forms in terms of 'generalised cylinders'; the idea is that the visual system composes the shape of a wine-bottle as a long, narrow, cylinder whose diameter is especially narrow at the top; a sugar-lump would be a short, fat, cylinder with a squared cross-section; and a snake would be a very long, very thin, cylinder with a curved. Instead of ‘realistic' visual interpretations, Impressionists concentrated on light patches. Understanding the difference between distinguishing colour patches and perceiving them as water lilies is something that a painter like Monet can teach us. In fact, computational theories (and computer models) of vision imply that human visual impressions are built on a number of successive representational levels.3 Colour patches and line segments are recognised quite early in the visual perception process. Later follows the building of actual surfaces that are positioned in relation to the viewer's present location. Construction of solid things that are autonomously positioned in three dimensions occurs much later. The penultimate step in the construction process is the identification of named objects, such as water lilies. The Impressionists effectively served as a reminder of (some of) this and a model for what human vision may look like if we were unable to calculate interpretations at higher levels.

The Impressionists were fully aware of the connection between their creative approach and visual psychology, which they extensively addressed. Scientific ideas have also influenced other painters. For instance, Bridget Riley's canvases are based on psychological research on optical illusions. They perceive poetry in what I've done, said the Pointillist Seurat, who based his colour selection on theories of optics. No, I just use my approach, that's all there is to it.'4 However, the majority of creative people are happy to dismiss theorising about how the mind functions. Even while they covertly take use of their intricacies in their profession, they take our daily talents for granted. In order to contrast the melodious "Quinquireme of Nineveh" with the "Dirty British coaster with a salt-caked smoke-stack," John Masefield did not need to take a course in phonetics or speech perception. The director of the 1962 James Bond movie Dr. No also didn't need a psychology degree to foresee that Sean Connery would draw attention to the Duke of Wellington picture in Dr. No's lair, which had just been taken from the National Gallery. There are many private and not-so-secret jokes like this one throughout the arts: consider the in The Waste Land references. Such joys are made possible because artists have an excellent intuitive understanding of what the human mind is capable of (even nuclear physicists sometimes engage in such games; otherwise, they wouldn't talk of "quarks").

However, the psychologist cannot assume that we will always be able to function normally. Instead, the goal is to comprehend them as clearly as possible. How can we become aware of something? How might we mix well-known concepts in fresh ways? How do we understand English phrases, recall information, and comprehend analogies? Computerised psychology may assist us in locating the specific processes behind our daily activities. Creativity (and its appreciation) would not be possible without these systems. Newton cannot exist without notice. No comparison means no Antonioni. And Mozart wouldn't exist without memory. It is obvious that MozArt had a remarkable memory—at least for music. There are several stories of his being able to recall full cantatas after just hearing them once whole symphonies before ever.

Anecdotes are untrustworthy, that much is true. A person as incredibly creative as Mozart draws an accumulation of tales, not to mention myths, some of which are outright untrue. One well-known phrase, which Hadamard cited and which his readers often recited, is possibly a forgery.5 Mozart did not likely write the following: "[Sometimes], thoughts crowd into my mind as easily as you could wish." Where do they originate from and how? I don't know, and I'm not involved in it. Then my soul is on fire with inspiration,' nor did he write (a few lines later) "It does not come to me successively, with various parts worked out in detail, as they will later on, but it is in its entirety that my imagination lets me hear it," nor did he write (a few lines later) "I keep those that please me in my head and hum them."

Since the middle of the 1960s, musicologists have disregarded this fictitious "letter." However, some authors on creativity are still citing it unqualifiedly 25 years later (tact prohibits referrals!). It is, of course, irresistibly appealing since it supports our hero-worship of Mozart and fits in with romantic and even inspirational viewpoints. (I am reminded of Voltaire's statement that if God hadn't existed, He would have had to be invented. Why? How?)

Particularly believable are the comments about imagining the song "in its entirety." many pieces of evidence indicate that Mozart and many H-creative persons were capable of 'all at once' (as we say) conceiving a whole conceptual framework. Like the sentence from the fake letter, this explanation appears to be a logical approach to convey what many H-creative individuals have told us. This way of thinking was characterised by Coleridge's concept of the poetic imagination, in which the author envisioned The Ancient Mariner as a cohesive architectural structure. Additionally, it seems that Mozart was capable of being aware of both the general shape and the articulated inner structure of a work at the same time. But does this mean that the creative elite has some kind of unique power? Or is it a more advanced form of a power we all possess?

An explorer on Earth may see over a whole valley, observing it both as a patchwork of roads and settlements and as a glacier formation in the surrounding mountains. Both a partygoer and a fashion designer can simultaneously see the structural outlines and intricate details of a ball gown. Even the song "Where Have All the Flowers Gone?" comes to mind. “in a flash." Okay, perhaps. Do the flowers, girls, boys, and warriors really dance together when you imagine them to? Or maybe it would be more accurate to say that the subsequent lyrics and pictures come to mind practically simultaneously? Do we just mean that we can see the lyrics' abstract, 'circular' form, possibly with the melody's opening note tossed in for good measure, when we talk of picturing the song all at once? Without a doubt, there are moments when we may see a hierarchical structure at multiple different levels of detail at once. For instance, we don't need to go closer or adjust our vision to perceive the pattern of herringbone tweed, whose stripes are composed of smaller stripes. But what about literature, folk ballads, glacier valleys, or even the structure of a cantata or a symphony? Really, do we encounter such complex systems all at once?

We are once again having trouble with reflection. It's possible that the most natural way to describe a certain experience—to you, me, or even Mozart does not accurately reflect what awareness is truly experiencing. It does not even fully describe the underlying memory-processes. Even if we actually perceive the valley or the folk song simultaneously, it is still unclear what kinds of computation allow for this to happen. This situation is crucial to our consideration of frames in Chapter 5. The representation of a frame identifies both the elements in the slots and the frame's general structure. Some spaces may not be identified as vacant but rather left open-ended. Others might have their dull default values filled up. Others may have been filled by examination or mental decree, boringly or otherwise. Without any slots, a frame couldn't be represented. And it wouldn't be common for every position to stay vacant indefinitely.

Even if pure mathematicians want to define frames with the most abstract slots feasible. They may represent structures on several hierarchical levels since some frames include or provide pointers to other frames; once again, some of the slots and sub-slots will be filled. It makes sense that we often seem to be aware of a structure "in its entirety" if frames represent part of the computational structures in our minds. Similar observations may be made about the other abstract schemas we've covered, such plans, scripts, themes, or harmony. Plans feature organised collaborative areas that depict objectives, sub-objectives, decision points, barriers, and action operators. Is it a surprise, therefore, that occasionally your route to London for tomorrow may flash 'in its whole' in your head? Consider the phrase "script going to sales" or "escape": don't they invoke a variety of distinct but structurally connected concepts "all at once"? Although, as we have shown, the home-key must be established first, even listening to a melody appears to include the recognition of general harmony "at the same time" as accidentals, modulations, or discord. These commonplace examples imply that Mozart's abilities were comparable to those of the rest of us, with the exception that he was able to do them more effectively. For valleys, ball dresses, visits to London, and possibly folk tunes, we can do anything. He could play symphonies in that way.

He could do it better since he knew more about the necessary structures, at least as far as music was concerned. As was already said, memory retains information in the conceptual areas of the mind. The potential of storing goods in a discriminating manner and first recognising their particularities increases with more extensively organised (and well-signposted) the places are. (In general: the more frame-slots, the more structurally-situated information.) As we've seen, children explain and differentiate their talents on many levels, which leads to their being more inventive. Adults probably do the same. You couldn't enjoy a herringbone suit if you couldn't see stripes and mini-stripes. A moraine cannot be recognised by someone with no prior knowledge of glaciers, and so cannot be remembered or imagined. Additionally, someone who has no knowledge of tonal music is unable to discern a modulation or a plagal cadence from the sounds of a Western folk song. They need not be experts, but verbal labels may sometimes 'fix' memory schemas. In sum, Mozart's unusually developed musical memory was a key component of his brilliance. Mozart is one of the very few individuals who has a consistent, long-lasting capacity to develop H-creative thoughts, therefore HE worD 'ENIus' comes to mind here. Gauss was one more, and Shakespeare was another. How is it even possible? To put it another way, how can there be a level of P-creativity so high that H-creative concepts are repeatedly produced again?

What we identify as 'H-creative' depends to a large extent on historical accident and social fashion: several unpublished Mozart scores turned up in the 1980s. Even Mozart was not always regarded as highly as he is today; he was buried in a pauper's grave, and his music went out of fashion in Vienna. There are several ways that thinking may be H-creative—indeed, superlatively H-creative. For instance, some musicians claim that Haydn was more adventurous than Mozart and that he questioned the laws of music more often than Mozart did. If so, Mozart's H-creativity was more about pushing the boundaries of the norms (and bending and altering them at many unexpected moments) than it was about fundamentally violating them [11], [12].

CONCLUSION

In other words, the brilliance of a Mozart symphony might be largely based on the intricately woven musical equivalents of Dickens' experimental use of seven adjectives to qualify one noun: we hear it with delighted amazement, because we had no idea that the relevant structural constraints had such a potential. Even if one agreed with this musical assessment, one may still think of Mozart as the superior genius, possibly because his music is more varied than Haydn's or because it demonstrates the full potential of a certain genre while not having created it. Whether or if there is H-creativity that is depending on style. It must include the investigation of conceptual areas since it would be an unusually profound alteration. Therefore, competence is crucial. One cannot violate or bend the rules if they are not known to them (not even implicitly). Or rather, it is impossible to do so methodically. But being methodical alone is insufficient. A system (the alphabet) was being explored by the cartoon-Einstein and his very next idea would have been "$e = mc^2$." However, as there is nothing unique about the letter "c" in the alphabet, nothing connecting it to the speed of light or any other scientific notion, the cartoon Einstein could not have identified it as the object he was seeking for. Even routine P-creativity calls for systematic rule-bending and breaking that is carried out in domain-relevant ways.

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CHAPTER 11

HUMAN AND THE HOVERFLIES

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ABSTRACT:

Summer time vacation beaches provide an uneasy minuet, performed by approaching spume waves and receding deck-chair waves. The deck chairs are periodically pushed up the coast as the tide comes in. The sunbathers can only really unwind when they are secure above the high-water mark and are certain that their domain cannot be further intruded upon. Similar trends may be seen throughout the history of science, with anthropocentrism retreating as scientific theory advanced. The notions that the Earth is the center of the world, that homo sapiens was made in the likeness of God, and that humans are inherently rational beings were all put to the test by Copernicus, Darwin, and Freud, in that order. The deck chairs of our self-glorification have been moved about a lot since the Renaissance. In this scenario, human creativity is even further up the beach than logic. There, in peace and assurance that they are secure from science, inspirationists and romantics recline. However, is their optimism misplaced? After all, there are occasions when the high tide completely engulfs the beach, forcing the deck chairs to be removed. Is originality untouchable? Well, each of the three intellectual revolutions mentioned above disproved a long-held assumption. Geo-centrism, special creation, and logical self-control all fell by the wayside. We might regretfully add a fourth example to the list if current science were to assert that creativity is an illusion. But this is not what science says. The preceding chapters have often acknowledged innovation. In conclusion, scientific psychology explains creativity rather than rejecting it.

KEYWORDS:

Computer, Creativity, Hoverflies, Human, Science.

INTRODUCTION

But saying this is insufficient. Many individuals worry that an explanation by itself has to diminish creativity. For the time being, ignore computers. It is believed that any scientific explanation of creativity will irreparably diminish it. Even a justification based on brain processes (let alone silicon chips) would be insufficient to maintain our respect for original thinking. This popular mindset has a lot to do with the perception that science, in general, kills wonder. Wonder and creativity go hand in hand. By definition, all creative ideas are valuable in some manner. Many of them leave us in astonishment and joy. The water snakes delight us, and the benzene ring fascinates us. It would be nearly as awful as rejecting creativity completely to prevent us from marvelling at the ingenuity of Bach, Newton, or Shakespeare. Therefore, many individuals see the scientific study of creativity as more of a danger than a promise. This kind of non-scientific research is not brand-new. William Blake had a term, or rather, many words, for it. May God keep us, he wrote [1], [2].

From Newton's slumber & Single vision!' Once more I look at the European Schools & Universities. And there it is: the Locke loom, its terrible woof washed by Newton's water wheels, and the fabric is black. Cruel Works are folded like thick wreaths over every nation. In contrast to those in Eden, which revolved Wheel inside Wheel in freedom, harmony, and peace, I see countless wheels that are connected only by gears that are moving tyrannically against one another. This passage functions in part as a protest against the Industrial Revolution's machine shops. The wheels of science and technology are, however, also known as "the water-wheels of Newton." Blake's criticism of machines and how they were transforming our civilization went beyond that. The crystallised spheres (the wheels within wheels) of mediaeval cosmology were not something he was endorsing either. He was responding in opposition to Alexander Pope's assertion that "God said, "Let Newton be!For Blake, the light of Newton allowed for just one kind of vision. Freedom and harmony, two topics beyond the purview of natural science, were subtly devalued, disregarded, and even implicitly rejected.

Despite Blake's assaults, science continued to advance quickly. It gave rise to many new hypotheses and facts. However, concerns about the scientific way of thinking persisted and still do. Some sceptics used comedy as a weapon; for example, in his 1830 novel The Mudfog Papers, Charles Dickens made fun of the young British Association for the Advancement of Science, sometimes known as "the British Ass." Theodore Roszak and others in the 'counter-culture' of the 1960s wrote anti-scientific works were more passionate, though less humorous, for one. They shared Blake's condemnation of science, which later will be examined, for what they saw as its mechanical denial of freedom. They specifically demanded a restoration to religious awe or respect, if not to theological orthodoxy. The Athenaeum contributor from the nineteenth century expressed it succinctly. He had travelled to Edinburgh for the British Association conference in 1834 in a stagecoach with several distinguished members of science [3], [4].

We crossed the Cheviot Hills into Scotland. Everyone was intrigued by their look, and it quickly became clear that our fellow tourists were Association members who were well-versed in their various fields and ready to share and receive information. ...The field of Chevy Chase hardly elicited a comment. One of the geologists noticed that the cross marking the spot where Percy fell belonged to the secondary formation. The mathematician noted that it had deviated from the perpendicular. The statisticians then started a discussion on the relative carnage of ancient and modern warfare. (Italics inserted.) We have all seen scientifically oriented people with mindsets like these, who are full of their own expertise yet unaware of history and insensitive to the beauty of the natural world. But does science inevitably kill romance (we have all personally seen annoying artists)? To be sure, it does sometimes. The romanticism of superstition, which includes beautiful and inspiring "theories" of creation, is fundamentally at odds with science.

An engineer buddy recently recalled how, as a small boy, circles completely captivated him for a period of time. He would save the circular objects he collected in his toy cabinet, such as coins, bottle tops, and tins, and use them to make circles of all various sizes. His parents informed him about a device that can draw any circle (up to a specific size) one day. He was really intrigued by the concept and couldn't wait to get this treasure as a present. He imagined it to be some type of magically altering object that might change. Then a compass was handed to him. He was quite disappointed to discover that the compass had no magic at all. It was tediously straightforward, and even a baby could see through its "power." This day of disappointment is still fresh in his mind as a devastating experience from his youth. However, he now had the wisdom to see that the mathematical theory the compass represented was even more beautiful. Only those who believe that baroque complication is a required characteristic of the marvellous will find its simplicity, which may produce numerous situations with superficially varied circumstances, to be uninteresting. Even Blake did not think this, which is why he used the word harmony [5], [6].

DISCUSSION

Sometimes, this new awareness causes us to respond to things just as the young engineer did when faced with the compass. That is, the recently revealed simplicity stifles our feeling of magnificent mystery and drives away our sense of wonder, leaving us with nothing but the bare facts of science. Take the hoverfly as an illustration. Since they must be in the same location to mate, it is fortunate that a hoverfly may encounter another one in midair. How does this encounter take place in the air? When a hoverfly sees a buddy across a city square, one may presume that they act similarly to people, promptly changing course and making any required adjustments if the friend abruptly veers off course. Sentimentalists would wax lyrical over the marvels of nature, exemplified by the amazing abilities of the common hoverfly. Given the underlying premise, more sober people would sympathise with this point of view. However, it seems that this presumption about how the hoverfly organises its social life is incorrect [7], [8].

When examined more closely, there is nothing comparable to the flexible choices and Truly intelligent friend-seeking behaviour involves a variety of neural circuits. For a very straightforward and rigid rule governs the fly's flight path. This rule converts a certain visual input into a particular muscle reaction and is programmed into the insect's brain. The target fly's current specific approach angle will determine how the fly will change directions. In essence, the creature always thinks that the size and movement of the observed target—which may or may not be a fly—are those corresponding to hoverflies. Upon starting its the fly chooses its angle of turn based on this inflexible and unreliable principle for each new flight-path. Furthermore, since the fly cannot be affected by input from the movement of the target animal, its direction cannot be changed mid-flight. Anyone who had been intrigued by the analogy between the hoverfly's conduct and humans' capacity to intercept their friends must find this evidence disappointing. With a fury, the hoverfly's intellect has been shown, and it no longer seems to be deserving of any awe.

Undoubtedly, the evolutionary processes that allowed this straightforward computing mechanism to arise and the biology that underlies its operation both possess beauty (much like the beauty of the compass). However, using anthropomorphic adjectives to describe the fly itself is inappropriate. Even while we continue to be in awe of evolution and insect neurophysiology, we are unable to continue to be in awe of the hoverfly's complex intellect. Many people worry that science's disillusioned rejection of the hoverfly's intellect is a preview of what it will say about our own brains. However, this is incorrect. Our earlier admiration for the insect's intellectual capacity is shown to be only uninformed romanticism since the hoverfly's thinking turns out to be considerably less amazing than we had assumed. However, computational studies of thinking might heighten our appreciation for human brains by demonstrating that they are much more intricate and complicated than previously thought.

Consider the numerous different ways Kekulé may have seen snakes as implying ring-molecules (as shown in Chapters 4 and 5). Consider the rich analogy-mapping in Coleridge's head, which produced the brilliant water-snakes that swam through Chapter 6 and relied on naval memoirs, trip stories, and scientific reports. Or keep in mind the complicated brain processes that underlie a believable and elegantly written tale (as described in Chapter 7). The rules for melodic contours in the jazz programme are an example of a very basic computational idea that, like the compass, may provide unexpectedly rich outcomes. By pinpointing the mental operations involved in cases like these, scientific psychology can show us just how amazing the human mind is. To be fair, poets and novelists have always had a heightened intuitive awareness of some of the relevant psychological nuances. Consider

Coleridge's (and Livingston Lowes') observations on mental association or Proust's brilliant description of memory. Similar findings were used by theoretical psychologists like Freud to explore symbolism in waking dreams and daily dramas. But rather than being supported by solid science, these ideas have remained poetic and intuitive. Additionally, even Freud undervalued the complexity of the mind.

He explained. Koestler also attempted to define "the bisociation of matrices" in this manner. It would be "the fallacy of the compass" to stop being amazed by creativity because it had a scientific explanation. The young engineer's brief disaffection was unneeded and unreasonable. He still admires circles for their aesthetic surface appeal. But he also recognises the fundamental mathematical idea that underlies them and makes it possible for anybody with a compass to produce them. Instead of losing, he gained. Therefore, a scientific psychology gives us enough freedom to speculate about Mozart and even Grandpa's jokes. In the same way that geology maintains the Cheviot Hills' impressiveness and Chevy Chase's poignancy, psychology maintains poetry. In fact, it gives our wonder at discovering water snakes or the benzene ring theory a whole new level [9], [10].

A similar remark about biology was made by Darwin. He asserted that evolutionary science might heighten our awe of God's creation rather than lessen it the concept that God created the rhinoceros of Java and Sumatra and that he has created a long line of repulsive molluscs since the Silurian is, in my opinion, a product of a limited imagination. How demeaning for someone who is claimed to have said, "Let there be light," and it really happened. The fact that all of these species, as well as their more visually pleasing counterparts, were created by "the body's laws of harmony," he said, is "the more magnificent view." After reading Darwin's statements above, some people may respond, "H," "But there's the catch! The rules of harmony inside the body are one thing. Brains may be innovative in some way. Computers, meanwhile, are very different!' There are at least three different interpretations of this objection. These bring to mind, successively, the first, second, and last Lovelace-questions. It can imply that computers have no place in the study of human creativity and are thus unable to aid in its comprehension. It may imply that computer performance will never be able to compete with ours and that Chopin or Donne will never be produced on a machine. Alternately, it may imply that computers lack true creativity in comparison to humans.

The first interpretation is that computers are completely inhuman. In contrast to computers themselves (which are irrelevant to human creativity), computational notions and theories are essential for psychology. The goal of computational psychology is to describe the conceptual frameworks and thought processes that individuals use. It is not necessary for a given calculation to be implemented in silicon, gallium arsenide, or any other material created by computer engineers. It could be a typical neuroprotein at action in human brains. Despite this, computers are incredibly helpful since their programmes are efficient processes. We know that fundamentally comparable calculations anchored in the brain may be the basis of authentic, live jazz if a jazz-program can make listenable music. Anyone with reservations about how the brain operates may be in the right. However, they should back their claims with specific facts rather than generalised assumptions. (Johnson-Laird makes this claim when he claims that limitations on long-term memory prohibit jazz melodies from having strings of motifs and that limitations on short-term memory prevent jazz melodies from being improvised by hierarchical grammars. The sceptics should ideally provide a different psychological theory that is equally clear and has more generating potential. If they are successful, the original theory will have been scientifically productive even if it was rejected (a usual outcome for original ideas in science). If they don't, the disputed theory continues to be the most compelling hypothesis up to this point.

As we have seen throughout this book, there are several hopeful interpretations. Even emotion and motivation have been studied computationally, albeit the ideas are still in their infancy. There are various ways in which a computational approach might aid in the explanation of human creativity, despite such theoretical inadequacies. It allows us to understand the potential mechanisms behind our capacity to pick up new ideas (patterns) and combine them in creative ways. Additionally, by thinking about conceptual spaces in computational terms, their capabilities to be mapped, explored, and modified become more accurately understandable. For instance, the notion of a generative system helps us comprehend how concepts might emerge that, in a significant way, could not have existed before. We can assess how greater or less drastic changes may be made by concentrating on the ways that science and the arts think. Musicologists, literary critics, and art and science historians are interested in these issues, and we need their perspectives if we are to comprehend creativity. Numerous of these discoveries are difficult to articulate in specific language because they are so subtle.

The arts of harmony, jazz, and line drawing, as well as different forms of scientific innovation, shown that computational psychology can already make specific claims about these topics. In contrast to verbal ideas that are only loosely grasped, computer modelling allows us to evaluate our psychological theories by expressing them as practical operations. It enables us to understand how difficult and yet confined it is to appreciate music or its improvisation. It confirms several scientific findings from earlier eras and honed our understanding of what specific ways of thinking can and cannot do. Additionally, it supports the idea that, for certain reasons, altering how an issue is represented might make it far less challenging.

We can better comprehend how a variety of H-creative concepts may have developed if we consider the idea of heuristic search that is regulated in certain ways. Scripts and related ideas show some possible mental organisation schemes and make it easier to understand the wide range of restrictions that come with story writing. The 'un-naturalness' of sequential programming is essentially unimportant since the brain may be exploring conceptual spaces with dimensions that are represented by sequential models, despite the fact that it often utilises heuristics, scripts, and frames in parallel. This approach emphasises the variety and nuance of 'ordinary' psychological talents. We are able to comprehend the potential roots of creative thought considerably more clearly than Coleridge or Koestler were able to. And it is clear how many more limitations, in addition to grammatical rules, must be included into even the seemingly simple job of describing a game of noughts and crosses. Furthermore, theories about the brain serve as part of the inspiration for computational psychology. We can get a handle on the fleeting psychological processes involved in poetic imagery, scientific analogies, and serendipity using connectionist models. They outline strategies for universal recognition in which a large number of characteristics suffice rather than a single trait. Additionally, they demonstrate how a mind—or even a computer—can accept erroneous pattern matches and obtain a whole associative complex from a fragment. Given the creative settings of molecules and seafarers, snakes and water snakes become less mysterious as a result.

In order to describe the conscious thinking that occurs during the assessment phase (and often throughout the planning phase as well), connectionism must be supplemented with other types of computational theory. The construction of "hybrid" systems, which combine flexible pattern-matching of connectionism with sequential processing, is one of the most active study fields at the moment and a hierarchical organisation. Both ways of thinking must be addressed in a psychological theory of creativity, as well as how they may coexist in the same mind. I've provided several other instances to back up my assertion that the first Lovelace-question justifies the response "Yes." Nothing I could say at this point would change your mind if you still aren't persuaded. Regarding the first use of the phrase "Computers are another matter!"I rest my case," I said. The issue is more difficult to refute under the second meaning.

Future psychology must attain a thorough knowledge of them if future programmes are to match all of our creative abilities. The computational method has significantly improved our understanding of the human mind and its possibilities. We will undoubtedly have a better grasp of these issues thanks to neuroscience. But there are still a lot of unresolved issues about human thought, many of which have not even been raised. Why should anybody think we would be able to resolve every one of them? We can't possibly cover every inch of theoretical psychology's conceptual area here. Perhaps the mysteries of Chopin's music and Donne's poetry lie in those uncharted territories. Similar to how certain physical illnesses may never be fully understood, studying physiology and molecular biology is not a waste of time. All feasible scientific questions cannot be addressed by science, much alone asked. Even if it were possible, scientists wouldn't want to squander their time and resources by combining all these explanatory concepts into a single computer model. (Combining BACON with its four P-creative relatives is child's play in contrast.) Some specialised computer systems will undoubtedly be constructed, to accomplish for other sciences what DENDRAL achieved for chemistry—and much more. However, there are simpler and more pleasant methods to discover new wits and poets.

The abundance, unconscious, and non-verbal nature of the matrices that interlace in the aesthetic experience, along increasing gradients in multiple dimensions, rather than the aesthetic experience's irreducible quality, is what makes it difficult to analyse. How many and very diverse these dimensions are were hinted at in the chapters that came before. It would be almost hard to combine them all into a single AI model. Furthermore, as shown by Proust's madeleine, human creativity often entails very unique experiences. However, theoretical psychology is more interested in generic principles than in people's specific histories or rumours. Even when a psychologist does describe in-depth personal evidence (as in Darwin's notebooks, where one can follow the progressive development of the notion of evolution), they are just utilised as fuel for theorising. A computer model must be given some substance, something unique to think about, in order to incorporate universal psychological concepts. As we've seen, it may be put to the test using Socrates' philosopher-midwife comparison. Even if it were possible, it would not be worthwhile to include all of Socrates' wisdom and experience, including his disputes with Xanthippe and his familial ties to the genuine midwife Phainarete. But without doing so, the intricate texture of Socrates' ideas would not have been modelled, and his originality would not have been adequately encapsulated. This has nothing to do with Socrates' genius; you can't fully mimic your own or your neighbor's inventiveness either.

Up to an extent, future computers will function "creatively." The answer to the second Lovelace question is a cautious "Yes" (arguably, some already do). However, it would be absurd to expect a computer model to perform as well as Chopin or Donne. It would probably be too difficult to even attempt to replicate the humour and wisdom of a schoolgirl's letter to her closest friend. A computer Shakespeare must be awaited like Godot. Computers are very different, according to the third interretation matter' poses a variety of unique and challenging questions. No matter how great their performance may be, it maintains that computers are fundamentally incapable of true innovation. Let's suppose for the sake of argument that machines could one day seem to be just as creative as humans are. As with us, they could have certain blind spots. For instance, they might only have a theoretical, textbook-based understanding of sneezing and chilblains (two examples from Chapter 1). But they would come up with many concepts that were just as interesting as ours, including cantatas, theorems, paintings, theories, and sonnets. And they would do this using computing processes like to those that theoretical psychologists claim occur in human brains.

However, this criticism argues that they would not be very inventive. They would not, in fact, be very clever. Intelligent machines (on this view) is comparable to fake five pound bills rather than fake light. It is completely different from anything of the same kind, far from being an example of that; to claim otherwise would be to commit fraud. "Well, the question is very obvious! ‘What’s your response to it?' you could inquire. “Not so quickly!" This relates to the fourth Lovelace question: Is it possible for a computer to be creative? Furthermore, this issue is not at all obvious. In fact, there are (at least) four different strategies to argue against the response "No." These are what we'll refer to as the "brain-stuff argument," "empty-program argument," "argument for consciousness," and "argument for non-human." The "brain-stuff" argument is based on the fact that metal and silicon cannot sustain intellect, but neuroprotein is a kind of substance that can. The empty-program argument advances the metaphysical assumption that all of the symbols used by a computer programme have no significance whatsoever to the machine. Similar to this, the awareness argument maintains that no machine could possibly be conscious. In addition, the non-human argument maintains that considering computers to be fully intelligent is not only morally repugnant but also a factual error (much like arguing that a hoverfly's blood is precisely the same as ours).

We must take into account each of these four points because a person who maintains that computers are incapable of true creativity may have one (or maybe all) of them in mind. As we have seen, ovErFLIEs are not particularly brilliant. However, the "brain stuff" argument contends that even hoverflies have a much higher claim to intellect than do computers. To the extent of the exact value of computer intelligence is zero. It is more true to say that computers constructed of inorganic materials must always be incapable of intelligence. Only 'biological' computers made from synthetic or naturally occurring organic components are capable of true thinking. Hoverflies, which have a genetic makeup similar to that of humans and have a body composition that is mostly similar to ours chemically, may have a tenuous grasp on intellect. Computers however, cannot. No biology, no creativity, in a nutshell. This argument's central factual premise may, theoretically, be accurate. It's possible that computers are constructed from a kind of material that lacks the capacity to sustain intelligence. In fact, it's possible that neuroprotein is the only material in the cosmos with this capability.

However, it may not. It may not even be essential to have benzene rings or carbon strings since there may be creative intelligences on Mars or Alpha. Centauri, their brain filled with extraterrestrial poisons. This is not implausible, according to science. "Ignore the Martians!” ‘We’re talking about computers,' someone would remark. It is apparent that neuroprotein can sustain intellect but metal and silicon cannot. However, this is not at all evident. Undoubtedly, neuroprotein fosters creativity, meaning, and intellect. However, as a neuroprotein, we know very little about how it functions in contrast to other molecular components. In fact, to the extent that we do understand this, we concentrate on the neurochemistry of a few fundamental computing tasks performed by neurones, such as message-passing, facilitation, inhibition, and similar tasks. For instance, neurophysiologists have learned about the ‘sodium-pump'. This electrochemical mechanism, which takes place at the cell membrane, allows an electrical signal to go from one end of a neuron to the other without losing any of its intensity. Additionally, they have researched the biochemistry of neurotransmitters, which include acetylcholine and may either make it simpler or more difficult for one nerve cell to trigger the firing of another. In a few instances, they have even been able to speculate on how a cell's chemical characteristics (and connectivity) allow it to encode some types of information rather than others, such as picking up gradients in colour or light intensity or noises with different pitches.

We couldn't enjoy music if we couldn't distinguish between sounds with different tones. Harmony heuristics like those previously mentioned may only be used if it is audible, for example, that one note is a semitone below another. It would be great if the neurophysiologist could identify the auditory cells that allow us to accomplish this as well as the chemical reactions that take place. However, the neurochemistry is only intriguing to the degree that it demonstrates how tonal relationship computation is conceivable in human brains. Any alternative chemical would be OK as long as it also made it possible to calculate harmonic intervals. Similarly, in order to sketch acrobats or to appreciate drawings of them, we must be able to discern lines. But as long as the visual system could recognise light-intensity gradients, any chemical would work. Again, as long as they permitted a nerve cell to transmit a message from one end to the other and pass it on to other neurones, any chemical reactions would work at the cell membrane and the synapse.

Some computers already have the computational ability to recognise sounds and lines. However, there is much more to our own mental lives than just tonal harmony and line drawing. It's possible that human brains do additional types of computing that are incompatible with objects made of silicon and metal. However, at this time, we have no compelling basis to believe that. Possibly, too, but the vast array of stable but flexible structures that go into human mind can be implemented by neuroprotein in a reasonable amount of time and space. However, we have no specific reason to believe this (and what constitutes "manageable" anyway?). It makes no difference if we cannot comprehend how silicon and metal may support ‘real' intellect. In fact, we are unable to understand how neuroprotein, the mushy grey substance found within our brains, may possibly be able to do so [11], [12].

CONCLUSION

There are no dependencies between thought and matter that make sense. Nobody who was perplexed by intellect (as opposed to neuronal electrical activity) ever cried, "Sodium, of course. Electrical polarities and clanking metal are both just as 'clearly' ludicrous as silicon chips and sodium pumps, respectively. Despite being scientifically persuasive, the mind-matter functions of salt pumps and electrical polarities are not immediately understandable. They are very counterintuitive, on the other hand. We may expect our intuitions to evolve as science does. Future generations may come to view neuroprotein - and possibly silicon, too - as 'obviously' capable of encasing mind, much like we currently view biochemical substances in general as obviously capable of producing other such substances (a fact regarded as intuitively absurd, even by most chemists, before the synthesis of urea in the nineteenth century). Our intuitions, however, have nothing insightful to offer about the physical foundation of intelligence as of yet. The brain-stuff argument is, in essence, inconclusive. It serves as a reminder that machines constructed from non-biological components could not be capable of true creativity. However, it offers us absolutely no justification for thinking that this is the case.

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CHAPTER 12

EXPLORING THE EPILOGUE

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ABSTRACT:

The world advances. Since the first version of this book was created, computer creativity models that are superior to those from the late 1980s have been developed. Examples of combinational, exploratory, and transformative creativity are all included. These are intriguing because they shed light on our own inventiveness, much like the programmes mentioned in the first edition. The necessity for domain knowledge in defining conceptual spaces and the challenge of explicitly distinguishing aesthetic ideals so that they may be articulated in computer terms remain the two key impediments. A joke-generating programme named JAPE, created by Kim Binsted1, has been used to mimic combinational creativity.1 JAPE's jokes are not just "mere" combinations; they also have structure. They are clever riddles that every eight-year-old is acquainted with. For instance: What is a sad train known as? a little engine. What is a peculiar market referred to as? a peculiar market. Who has fibre among murderers? a deadly cereal. What distinguishes an automobile from leaves? after brushing and rake, whereas in the other you brake and hurry. They may not make you burst into tears of laughter, but after a few drinks, they could. However, they certainly elicited some wryly approving sighs at the unexpected pairings of, for example, "murderer" and "cereal" or "depression" and "train."

KEYWORDS:

Creation, Emmy, Epilogue, Letter, Style.

INTRODUCTION

These four puzzles were produced by JAPE, along with many more. Nine different sorts of jokes may be created by the programme using some very basic guidelines. One of its joke structures is: What sort of x has y? What kind of x may y have? What results from the union of x and y? Additionally, what distinguishes an x from a y? The joke-generating guidelines are only relatively' straightforward and much less more easily than most people would anticipate. AI continuously reveals to us surprising intricacies in our psychological capacities, as we have seen in the main text. Consider the intricacy of understanding (let alone creating) the joke about the cereal killer above, and then contrast it with the somewhat different complexity of enjoying the low-comotive or the weird bazaar. For each of the three, spelling and sounds are essential. In order to create (and understand) these riddles, you must have an associative memory that can hold a variety of words, including not just their meanings but also their sounds, spelling, syllabic structures, and grammatical classes [1], [2].

As a result, JAPE is given access to a semantic network with approximately 30,000 units, where new and appropriate combinations may be created. The network is an expanded version of the one that is mentioned (with mention of ARCS and ACME). It includes explicit knowledge of phonology, syntax, spelling, and syllables in addition to semantics, or meaning. (ARCS and ACME didn't require those additional dimensions since their analogies relied solely on meaning.) JAPE creates each form of humour by combining various combinations of these five characteristics of words in clearly defined ways. It is not sufficient to only offer the five dimensions; guidelines must also be provided to allow JAPE to find the proper components. In other words, each joke-scheme's appropriateness must be defined by the rules. It is obvious that an associative process that adheres to such limitations differs greatly from one that just selects random combinations from the network. Since JAPE's connections are far fewer and more 'obvious' than ours, it is primarily this that prevents JAPE jokes from being really humorous. Not to mention, many jokes created by humans aren't really humorous either. For example, consider the puns and riddles found within Christmas crackers. The success of JAPE is attributable to the fact that its joke templates and generating schemas are straightforward (a machine could even be able to assist the human joke-writer by providing ideas for subpar jokes like these). Binsted points out a few characteristics of real-world puzzles that JAPE doesn't replicate and whose (reliable hilarious) application isn't currently feasible. A massive connected system called Letter Spirit, which creates new fonts (new styles) for printing the Roman alphabet—typically viewed as a highly creative activity—has been used as a paradigm for exploratory creativity [3], [4].

This book wasn't much more than an outline sketch for a future implementation when it was created. The implementation is more comprehensive now than it was in 1995, when the sketch was more complex and only partially implemented. Douglas Hofstadter theorised in his astute observations regarding the psychological processes involved in font creation as to how one might recognise the uniformity of style, or "spirit," shown by each letter in a typeface a certain typeface, and how the designer might change certain letters and/or fonts to enhance the parallel being drawn. He saw Letter Spirit receiving a "seed" letter and having to first identify it as belonging to one of the 26 types of letters before producing the other 25 letters in a unified manner. As an alternative, the software may create a fresh seed for itself (using its understanding of letter categories) before generating the final typeface. In either scenario, the font style would progressively change as a result of ongoing research and adjustment to the many limitations involved [5], [6].

A good w may not be inspired by an exceptional (clearly distinguishable) a. In such situation, the font style will be changed to reflect the fact that the a must grow worse before the w may get better. The modifications will become more subtle as the design progresses, and they won't stop until some kind of equilibrium state is achieved where the internal coherence is maximum (or acceptable), albeit not necessarily flawless connectionist systems excel at satisfying several constraints. How to use that connectionist potential in this case for the specific example of typeface design was the issue. In essence, according to Hofstadter, Letter Spirit's methods of analogy-seeking would be quite similar to those in COPYCAT Specifically, they would be capable of parallel processing, probabilistic, competitive, multi-level, and ambiguity tolerance (or conceptual "slippage"). However, finding independent matches for straightforward letter strings is far easier than finding a style analogy that is cohesive over 26 different things, each with its own limitations, as COPYCAT did. (Either by itself or in the context of other letters written in the same manner, an or w must be distinguishable as an or a w.) According to Hofstadter, the programme would need to have four interacting "emergent agents." A fresh letter plan would be created (or modified) by the Imaginer. This idea would be turned into a concrete design by the Drafter and placed on the twenty-one-point grid that served as Letter Spirit's "sketchpad." The Examiner would attempt to "perceive" that pattern as a specific letter. As well as attempting to assess how similar or unlike the present letter (pattern) is to previous letters in the still-evolving design, the adjudicator would also attempt to characterise the stylistic characteristics of the pattern (so that they may be carried over to letter plans still to be developed). In a way, the four agents would carry out "top-down" operations.

DISCUSSION

However, they would evolve (or "emerge") through the interactions of several lower-level processes rather than being autonomously designed modules. Midway through the 1990s, Hofstadter's team had put in place a working Examiner. This programme could identify certain letters (such as an or a) in several different typefaces, which is not a straightforward task considering the vast array of design options the grid provides. Importantly, this considers the idea of the letter in question's structure. An f, for example, is imagined to have a vertical post and a horizontal crossbar. Letter Spirit may query if the bar must cross the post in order to be seen on both sides of it and, if the overall design of the font allows it, may respond "No."

However, the creation of new typefaces was still more a promise than an accomplishment. By the year 2000, the promise had mostly been fulfilled. The Examiner, the Adjudicator, and the Drafter are integrated under the 1999 implementation. The new Drafter, which operates directly on the sketchpad grid, now includes the Imaginer, which was previously available as a separate module. Compare a potter who mulls over his options for a long time before ever touching the clay with one who starts off by doing actual experiments. His new software can take five seed letters (b, c, e, f, and g), classify them (93.5% correctly, compared to 83.4% for humans), and then create a range of cohesive 26-letter typefaces based on the original (sometimes modified) seeds. The system is now being expanded so that it may be "inspired" by both letters it creates on its own and seeds that are provided to it. The programmers want to make it possible for it to draw inspiration from a single letter in the future. Now that we've covered letter type visual parallels, let's move on to architectural visual analogies. Let's also have a look at a modern architectural programme that creates floor layouts and "matching" facades for Palladian homes. The Palladian villa has favoured numerical proportions and dimensions, as well as a rectangular form as a general class (conceptual space). The rooms are only placed and proportioned in certain ways, and the interior walls split the layout into smaller rectangles. On his fundamental concept, Italian architect Andrea Palladio created several versions that are still visible as real structures or as drawings today. Additionally, he left some notes outlining his design process, including his propensity for "splitting" rectangles either vertically or horizontally. Regarding the precise nature of the guiding principles, however, art historians have long differed. The Palladian programme aims to make them more understandable [7], [8].

Three standards must be used to evaluate its success. First, it may create designs that nearly resemble those created by Palladio himself. Second, its capacity to create novel, Palladian-inspired designs that he could have considered but did not. Thirdly, it may prevent non-Palladian designs and buildings that Palladio would not have created. The latter two requirements call for historical analysis as well as aesthetic judgement evidence. Many of these conclusions are not very disputed. Both early iterations of the programme and buildings constructed by his imitators have several blatantly non-Palladian elements. These include interior hallways, lengthy, thin rooms, too many rooms, rooms of drastically different sizes, many internal (windowless) rooms, bays (even rectangular ones) projecting out from the rectangular boundary, and the biggest room located off the central axis. Of course, there is space for aesthetic disagreement in some of these situations. Palladio was not exactly imitated by human builders when they added bays, but it is questionable if they altered his architectural space in a manner that he would have liked if he had been asked.

It is more difficult to evaluate such 'departures' from the original aesthetic. For instance, Palladio seldom abandoned mirror-image symmetry and hardly ever constructed circular chambers. Should we consider someone who does this to be a genuine follower of Palladio's inspiration, or not? When is modifying a conceptual space considered to be transformation? Whatever we decide, the criteria for judgement have been made clear. There is thus a higher likelihood of agreement and meaningful discussion. However, this programme might be faulted for being an unreliable example of Palladian architecture. Early iterations yielded a lot of unsatisfactory designs, each of which required an impromptu "fix" to make sure it wouldn't happen again. An ideal programme would be one that can never produce undesirable designs. To put it another way, one seeks a "shape grammar" that produces only permissible (or "grammatical") forms. The concept of shape grammars is not new; in fact, a simple Palladian grammar was defined 25 years ago as a set of rules to be followed with paper and pencil.5 Another architectural shape grammar, also a pencil and paper exercise, describes Frank Lloyd Wright's Prairie Houses.6 The three-dimensional structures it generates include both various H-new houses in the same style as well as ‘repeats' of all the examples designed by Lloyd Wright. Each of these innovative (exploratory-creative) structures fits the genre to the trained eye [9], [10].

We are presumably meant to infer both that their stylistic unity is a mystery accessible only to aesthetic intuition and that only the intuitive genius of Lloyd Wright could have designed them. A world authority on Lloyd Wright's work, having devoted an entire chapter to the Prairie Houses, declared their architectural balance to be 'occult'. However, to suggest that anything is done intuitively just indicates that we are unaware of the mechanism involved. 'Intuition' is the name of a question, not a response, , as opposed to the opposite. And computational techniques could enable us to do that answer. In this instance, it seems that the Prairie House's essential features are captured by the shape grammar. The dimensions of a conceptual space might be more or less basic, as we saw in Chapter 4. The architectural language in issue in the instance of the Prairie House makes the distinction quite evident. Decisions about the presence, quantity, and kind of balconies are made extremely late, so they cannot have an impact on the overall layout of the home. As a result, additional balconies are seen as superficial both artistically and physically. By extension, choices about the fireplace (or fireplaces) must be made very early since they affect other, more basic, architectural considerations. One fireplace is seen in the majority of Lloyd Wright's Prairie Houses. On occasion, however, he added many fire places in lieu of the single hearth. The addition of a fireplace represents a significant change to the entire construction because of the fireplace's central position in this specific design. However, it will still be identifiable as a distinct variation of the Prairie House. The 'grammarians' in charge explain that altering the number of fireplaces creates 'a true prairie hamlet of separate but interacting prairie-style patterns' inside of a single structure.

One may travel into distinct areas of the conceptual space that differ from nearby regions in more or less basic ways since the language provides a variety of options at each decision point. Different "families" of homes reside in various parts of the area, and we may specify our intuitive perception of architectural similarity and dissimilarity in accordance with this. The concept of unity has been made apparent and is no longer occult. The expressiveness of musical performance is another component of human creativity that is often seen as being occult. For instance, pianists add characteristics like legato, staccato, piano, forte, sforzando, crescendo, diminuendo, rallentando, accelerando, ritenuto, and rubato to their playing in addition to using the two pedals. Yet how? Can we clearly describe this musical sensitivity? Can we define the relevant conceptual space, in other words? What is a crescendo? A rallentando is what? How abrupt is a sforzando, exactly? Christopher Longuet-Higgins9 posed these questions. Drawing from his past computational work on music (detailed in Chapter 5), he attempted to define the musical abilities required for performing expressively. He should have inquired, more precisely, how one reads the phrases and symbols (such the sidelong "V" for a crescendo) used in the score to denote expression. He omitted to inquire as to how one determines if a crescendo is even necessary in the first place.

Utilising the "Minute Waltz" and "Fantaisie Impromptu in C" by Chopin He learned some unexpected facts regarding the conceptual space in question. A crescendo, for instance, is not uniform but exponential; a uniform crescendo sounds nothing like a crescendo at all but rather like someone cranking up a radio's volume. Similar to this, for a rallentando to sound "right," the gradation must be exponential (in respect to the number of bars in the relevant part). The mind is very sensitive when it comes to sforzandi; the difference between an acceptable and awkward performance might be as low as one centisecond. In contrast, our appreciation of piano and forte is less sensitive than one would anticipate since, at least with regard to these two pieces, a performance is acceptable at just five decibels of volume. Longuet-Higgins' computer investigations have uncovered other truths similar to these, often verifiable in great detail. He notes that many intriguing topics relate to the degree to which they apply across a broad spectrum of music as opposed to a specific musical style. The expressive skill area that Longuet-Higgins has examined is being explored (and maybe even transformed) by a pianist whose playing style sounds "original." Of course, we may "intuitively" hear this uniqueness and either appreciate or reject the pianist's avant-garde approach. Recognising it and explaining it, however, are two other things. While Rosalyn Tureck's slow pace in her interpretations of Bach is readily apparent, many other emotional aspects of her playing are not. The work of Longuet-Higgins may be useful in understanding the range of possibilities in order to grasp, in rigorous terms, how such creative expression is feasible. Or how about writing music? There is no computer-generated "Beethoven's Tenth," as I said in Chapter 7 before going on to explore early music-writing programmes that prioritised jazz improvisation and nursery rhyme themes. And I acknowledged that the music they created at best resembled "a moderately competent beginner." Things are quite different now.

'Beethoven's Tenth' is yet unreleased. However, David Cope's Emmy (from EMI, short for Experiments in Musical Intelligence) programme has created a "Beethoven sonata." You can find the score for this new sonata in Cope's most recent book10 and listen to the first two movements on his 'classical' CD11 (Emmy knows nothing of expressiveness: the music on Cope's CDs is played by human musicians who couldn't play deadpan even if they tried.) if you want to determine for yourself just how Beethoven-like this new sonata is. Listen to another Emmy CD or check out some of Emmy's Mozartian pieces if that's more your style.12 (You may even think about an Emmy DVD.) (Admittedly, this is a poor example.) 13 Cope's most recent book also includes replacement versions of works by Scarlatti, Bach, Mahler, and Prokofiev, among others. In a previous book, he provided excerpts from compositions by Emmy-Joplin and discussed how she could combine various genres, such as jazz and classical music (think of the Swingle Singers)14. These genres can also cross cultural boundaries, such as baroque and Thai music, for example.15 The two genres can be integrated subtly or with 'brute force' methods, as in this case, while still maintaining each style's individuality. Whatever Emmy is doing is obviously quite generic in nature; any human composer may be cloned. However, it's also quite specific: this poser's music may be imitated, and the end product won't be mistaken for that one's. How is it even possible? The database has the specificity. This is a collection of melodic, harmonic, rhythmic, and decorative themes that serve as the composer in question's "signatures." For example, the "Beethoven" sonata takes inspiration from 10 of Beethoven's thirty-two piano sonatas. Cope, a well-known composer himself, chooses the signatures using his musical knowledge. Some of them are quite universal (for instance, a baroque style representative), while others are exclusive to one person's body of work. There are two sources for the generality. Emmy uses strong musical grammars that are represented as ATNs (augmented transition networks), on the one hand. In order for computers to understand words in English, ATNs were first created to represent English syntax. Cope modified them to represent the hierarchical structure of music. Emmy, on the other hand, varies and combines the available signatures using generic criteria.

Adventurous and Innovative Inventiveness

Of course, we're not talking about the fourth Lovelace query—namely, whether Emmy is'really' creative. Since this question has nothing to do with Emmy's music's composition or even quality, it is irrelevant. We are also not dealing with the second Lovelace question, which reads: "Does Emmy seem creative, yes or no? Such yes-or-no inquiries aren't useful, as we saw in Chapter 11. There is no all-or-nothing quality to creativity. Not even one that is continually graded (more/less). Many human ideas, including musical compositions, are so complicated that the question Is it innovative in this manner should really be asked instead. Is it artistic in that sense? What part(s) of it, specifically, is/are creative, and why? I'll leave it to you to consider these issues as you see and hear Emmy. If you do, you'll probably discover a lot of previously unknown complexities of human creativity, which is what we're mostly worried about. Again, expressiveness is not taken into account. For the record, there is now a jazz programme that can improvise in real time. However, this programme performs considerably better than a beginning with average skill. Jazz specialists on both sides of the English Channel have proclaimed it to be flying in Charlie Parker's territory (the most advanced version imitates Parker). Courtney Pine, a jazz saxophonist, has performed with it, and its programme director Paul Hodgson told me: "If I were new in town and heard someone playing like IMPROVISOR, I'd gladly join in."

Improviser is based on a database that can be modified to closely resemble a certain musician's style (Parker, Armstrong, etc.) and that can also be applied to non-jazz genres. It now does very well in exploring a wide musical spectrum. The investigations are nuanced, thorough, and (expressiveness aside) eerily believable. As the dimensions being investigated are pushed, there is some twisting and adjusting. But the environment does not change. Not because transformations couldn't be included—they could—using genetic algorithms (GAs). Instead, the issue is that IMPROVISOR is unable to reflect back on itself and assess its performance. Any assessment of the newly changed music would need to be done interactively, by a person rather than by IMPROVISOR itself, like the image-evolving programmes to be addressed below. Hodgson further contends that even GAs, as they are now administered, are incapable of bringing about a fundamental change. Although certain GAs may change the length of the "genome" and are thus not constrained to a specific set of possibilities19, the basic shape or size of the (astronomically many) options are still foreshadowed. Hodgson aims to design a fundamentally different strategy in order to get beyond this creative restriction, but he makes no guarantees. In a manner similar to how biological evolution developed perception organs that could react to new sensory dimensions, the programme would need to be able to produce new dimensions. In such instance, a future IMPROVISOR can take inspiration from Parker's jazz style growth as well as his performance.

Another excellent illustration of human inventiveness is painting. This encompasses both the selection of hues as well as the design of line and shape. Only the first was addressed by Harold Cohen's drawing-programs, which were discussed. Since Cohen hadn't yet created a colouring programme that satisfied him after years of trying, coloured versions of AAR-ON's artwork had to be painted by hand until very recently. However, he also displayed a colouring programme at the Boston Computer Museum in 1995. This version of AARON, albeit it has the option to focus on a certain family of colours, selects colours based on tone (light/dark) rather than hue. It uses a paintbrush to sketch shapes and five spherical "paint blocks" of varying sizes to colour the paper. In contrast to the programme directing their employment, certain distinguishing characteristics of the final painting style are caused by the physical characteristics of the dyes and painting blocks. To put it another way, this isn't a test of vibrant computer graphics. Instead, painting-AARON is a robot that performs actions in the actual world by employing tools. As a result, it may benefit from (as well as be limited by) the physical characteristics of objects in the environment. Painting-AARON is still being developed, just as drawing-AARON. The advancements are partly attributable to more powerful computers; around the turn of the century, Cohen noted that the RAM at his disposal was 16,000 times more than when he first began. The more difficult difficulty, however, was and still is how to explicitly state his colouring requirements in a way that is understandable enough for them to be coded [11], [12].

CONCLUSION

These regulations often lead to Emmy's creating a musical phrase that is almost exact to a signature that hasn't been supplied. This raises the possibility of a systematization in the specific composing style, which Cope may have seen instinctively (hence his selection of those signatures), but which hasn't been made apparent for Emmy, or possibly even not at all. If musicologists and music psychologists carefully examine what Emmy can and cannot accomplish, they could learn a lot. However, you could think that this is dishonest. Even if the jazz improviser in the book could only imitate "a moderately competent beginner," at least it was from scratch. It improvised its own tunes and built its own chord sequences by navigating a very complicated musical area. It didn't get a library of specific themes created by human master composers as Emmy does. Additionally, one must acknowledge that someone who writes in a regular, comfortable way is investigating as opposed to changing. Emmy isn't a good example of trans-formational inventiveness, unless you include its compositions in the baroque/Bali style. But as we've seen, they were the results of pretty brute-force combinations. Due to the fact that Cope's compositional rules have a relatively direct relationship to the steps of the compositional process, Hofstadter views Emmy as a sort of cheat—albeit a very impressive, even concerning one.17 Unlike Letter Spirit, he claims, Emmy doesn't "make its own decisions." As opposed to Letter Spirit, there are no repetitive cycles of creation, assessment, and modification. In other words, Hofstadter takes into account both the content and process of music production when determining whether to label Emmy as creative.

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CHAPTER 13

THE PROCESS OF CREATIVENESS

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ABSTRACT:

This book addresses issues relating to creativity, the creative process, and other similar topics, but it also attempts to utilise the book as an illustration of the creative process in action. In other words, it deals with the creative process while simultaneously acting as a kind of concrete illustration of it. I'll achieve this by presenting entries from my diaries that I made while I was writing the book. Innovation, progress, or imagination: the capacity to go beyond established concepts, principles, connections, or the like and to develop significant new concepts, structures, approaches, or interpretations, etc. creativity's importance in contemporary business and in the performing arts. Words like novel, inventive, and imaginative may be found in this definition. These phrases may be used to describe individuals in a wide variety of jobs and professions, from brain surgeons to carpenters and plumbers. We may reasonably infer what creativity is from these concepts. Like many other things, creativity may be hard to describe, but we can all recognise it when we see it. We shall discover a wide range of perspectives on creativity in the arts and other spheres of life in this book.

KEYWORDS:

Book, Creativity, Film, Process, Writing.

INTRODUCTION

We will investigate, among other things, the connection between our psychological states and creativity. Psychiatrist Isaac Silberman provides some insightful observations on the roots of creativity in humans (Personal Communication) Ideas for creative individuals come from several sources. The world is interconnected. One benefit of psychoanalytic thinking is that it enables certain people to cross conventional cultural borders. Free association theories, the unconscious, and a better knowledge of "nature" all contributed to this [1], [2].

The knowledge that sexual behaviour is normal and does not fall within the purview of religion also aided in facilitating the discussion. Our ten senses—smell, taste, hearing, vision, touch, emotion, space, time, and intuition—are used by artists. Intuition is the integration of subconscious thoughts that are translated so that more people can see or comprehend. Genetic influences are obvious and important. Albert Einstein, a genetic genius, also sought to comprehend arithmetic, physics, and the forces of nature and convey them to the world, particularly children. Mozart, a musical genius at age 5, created several symphonies and operas. Born autistic, Temple Grandin has overcome her disability with the aid of her mother and instructors to become a renowned speaker and authority on autism. She teaches animal behaviour as well. Some people are driven to assist others in order to overcome a hardship. Polio left Yitzhak Perlman with weakened leg muscles. He travels the globe teaching and performing using crutches. Some people combat their fears, anxieties, phobias, and other problems by engaging in constant artistic and creative endeavours. Silberman teaches us that it is difficult to predict when creativity will emerge and what drives creative individuals.

When the idea of examining creativity and the creative process "popped" into my brain one day while I was journaling, I made the decision to create this book.

Maintaining a Writing Journal

Since 1954, when I enrolled in graduate school at the University of Iowa to pursue a master's in journalism while concurrently attending the Writer's Workshop, I have maintained a diary. Currently on journal number 104, I've also written twenty or thirty shorter trip diaries that I utilised as sources for my travel books. Since 1954, I've essentially written in my journals every day. My diaries served as the starting point for the majority of the novels I've written, and the same is true of this one. I'll take from journal entry 103, which was written when I had the idea for a book about creativity: The days seem to pass quickly. Just a quick idea, but I've been considering publishing a book on the creative process. I can see two chapters, but what else? the social features of creative persons and the psychology of the creative process. The politics of creation, maybe. How about then? You may perhaps write a book on writing books about the creative process. In the absence of anything else, I may consider writing a book on creativity. Who in a university would utilise it? I just got as far as far in October. I was working on three other novels of mine that were being published at the time. I often have many projects going at once. While I wait for acquisition editors to tell me whether they will be publishing or rejecting one of my novels, I write a lot more books. I published several books with two tiny presses up until a few years ago, whose proprietors decided whether to accept a book of mine on their own or received decisions fairly fast. My novels have been with publishers for the last two to three months as of the time of this writing, and I haven't heard anything about them. Because I can self-publish my novels with Amazon.com's Kindle Direct Publishing Company, I choose to compose my books on six-inch by nine-inch pages. Up until Christmas, when I decided to see if I could write a book about creativity, the idea was in the back of my mind. Whether I would be interested in the topic. I noted in my diary on December 24. In the absence of anything else, I may write on creativity [3], [4].

An ethnographic analysis of the postmodern

This book was my 2:30 a.m. project. I've been getting up after a few hours of sleep, going to my study, and working on papers and books for many years. I normally spend a couple of hours writing before going back to bed to continue sleeping. So by 7:30 AM, I had completed some work. I'm going to begin journal 104, which I've given the title "Virtual," since all of my current social contacts take place online. I have given talks at conferences on languages and time in Moscow and India, and I have been interviewed by some media academics in India. I also provided an interview to some media professors in India. I kept thinking of new ideas while I discussed creativity, so I believe I have enough material to research and publish a book on the topic. I should also mention that, when I write a book, I generally don't have a plan to fill out; instead, I utilise the writing process as my guide. So, as bizarre as it may seem, the conclusion of a book always comes as a bit of a surprise to me. As you have already observed, I write in a conversational, casual, and approachable tone and often quote authors and thinkers whose thoughts I find insightful. In order for my readers to understand both what the authors had to say and how they stated it, I prefer to cite authors rather than paraphrase them. I should remind you that many academics dislike this approach, but readability is my first priority. I also like using a variety of drawings and other pictures to illustrate my works [5], [6].

Writing This Book in This Way

Many academic authors hold off on writing a book until they have a contract. They produce a book proposal that includes a chapter-by-chapter list, a sample chapter, a curriculum vitae, and information about the target audience. However, if their proposal is turned down, they will have wasted two to three months of their time, and if they submit it to a new publisher who likewise turns it down, they will have wasted six months of their time. They keep sending ideas up till they discover a publisher interested in their novel. If they manage to locate a publisher. My methods are different. I compose a book, send book ideas to publishers, and sometimes the finished product when editors want it. I've done things that way ever since I released my first book in 1970, which also happened to be my dissertation for my doctorate on the comic strip Li'l Abner.

DISCUSSION

I self-publish my novels if I can't find a publisher for them. I've published over 70 books through conventional publishers over the course of my career, and about 12 have been self-published. For traditional publishers, many of these publications are either too short or too unconventional. I spend a lot of time writing about the book I'm writing in my diaries as well. The process of creation for me entails writing in my journal about what I might write, typing something into my book on the computer, and then going back to my journal to discuss what I've written and come up with new ideas about what I might write. I normally spend a significant amount of time browsing through my collection of 5,000 books and seeking online for information I may utilise in my book. I discovered four books last night that had crucial knowledge on creativity: The Voice of the Symbol by Martin Grotjahn, Beyond Laughter: Humour and the Subconscious by Martin Grotjahn, Psychoanalytic Explorations in Art by Ernst Kris, and Fiction and the Unconscious by Simon O. Lesser. I looked over these books for a while, and I'll be using some of the information for my chapter on psychoanalysis and the creative process [7], [8].

Tehran's Ehsan Shahghasemi University

On the website of the Motion Pictures Association, Katie Manderfield (2013) stated: "... inspiration is not accessible on-demand. If you study film, you will constantly come across such claims regarding the relationship between innovation and success in cinema. "A good idea can catapult careers, spark motion picture franchises, and make cinematic history." Many individuals may have the impression that there are only a small number of filmmakers who are very clever and intellectual and who create works of cinematic art as a result of their brilliance. I am opposed. Instead of saying that this assumption is incorrect, I want to make the point that it is mostly incorrect. Talent is necessary but not sufficient to become a famous director, actor, etc. in the film industry.

First off, artistic creation in movies and in general is an abstract concept. In this regard, the very posthumous reputation of the great artists is instructive. A concept used for evaluation is creativity. Being creative is thus not defined by rigid standards but rather by a group of individuals who may be impacted in certain ways or who are already influenced by the opinions and values of a larger community. When money is involved, this problem is even worse. Winning an Oscar is regarded as the most prestigious event in the movie business, and success leads to money, opportunities, and even more success. If you are successful in the film business, you will probably continue to be successful in the future. Due to this, hundreds of millions of dollars are spent on influencing each year. By creating publicity for one's film or creating a "whisper campaign" against competitors, one might influence the Oscars proceedings. It is hardly surprising that those who lose the contest would criticise it, as previous Oscar winner William Friedkin did when he called it "the greatest promotion scheme that any industry ever devised for itself" (LA force, 2013: 1).

However, one can see the reality in such claims; factors much more significant than originality impact cinematic success. Second, the process of making a movie is lengthy and involves several people. The director of a film is often used to describe it, and although this is sometimes true, there are other factors we should take into account. The writing process often begins with an idea in the writer's head. Let's not go too far and adopt a teleological viewpoint that claims that an idea was always there but required special circumstances in order to enter the mind of a genius. A book is written by the author, and then it is adapted into a spec screenplay. It will then be transformed into a screenplay, and a screenplay is transformed into a more useful shooting script in which every scene is numbered and every aspect is decided. In truth, directors are often handed these shooting scripts, leaving them with little space for creative expression. After the whole film has been shot, it will go through post-production, during which not all of the filmmakers will have enough freedom to review their concepts [9], [10].

The original author, who conceived the concept and brought it to life using the simplest form of communication possible words possesses the greatest amount of creativity in this process. Because creating a tale with written words is more difficult than telling a story with words, visuals, and sounds together, it requires more inventiveness. The use of hyphens with directors seems to occur on occasion: director-screenwriter, director-producer, director-editor, etc. However, this does not alter the law. In the majority of films, the original idea had occurred to someone else. However, the director and the performers are perceived as being more innovative by the majority of uneducated moviegoers, who megalomaniacally believe they are more intelligent than book readers. Third, acting in movies doesn't need a lot of innovation or ability. Cinema performers primarily extol their acting prowess, and since there is a lot of money in the industry, there is a significant network of publicists and, sometimes, journalists who support their "extraordinary" acting skills. This postulation is mostly incorrect. In his 1983 mockumentary film Zelig, Woody Allen told us that during a party in the 1920s, Scott Fitzgerald saw a peculiar tiny guy by the name of Leon Selwyn, or Zelman, who looked obviously to be an aristocrat and exalted the extremely affluent while he conversed with socialites. In a posh Boston accent, he talked adoringly about Coolidge and the Republican Party. Fitzgerald was shocked to see the same guy chatting with the kitchen staff one hour later. He now claimed to be a Democrat, and from the sound of his accent, it seemed as if he was one of them.

Every one of us plays a role, and we all do it well. Every day, a typical male teacher assumes a variety of positions, including those of father, son, husband, teacher, fellow citizen, colleague, and brother, to mention a few. He does so naturally in each of these roles. We are so good at playing our many parts that one would question if there really is a genuine self. We read about renowned performers who unintentionally rose to fame, including Johnny Depp, Estella Warren, Rosario Dawson, Channing Tatum, Evangeline Lilly, and a host of others. Athletes from various sports, politicians, and scientists who rose to fame as actors nearly immediately are also included. You'll never hear of a chemist or physicist becoming well-known by accident or overnight! Moreover, success as an actor is not primarily influenced by inventiveness. All that is seen at the Academy Awards ceremony are stunning individuals speaking positively about an idealised world. Most of us are unaware that each of these individuals had to endure a violent competition in order to get there. Only the most resilient actors would make it through the very brutal battle for desirable and profitable assignments. According to a 2013 research, 91% of musicians are completely unknown on social media (Ulloa, 2014). Only 2% of actors earn a livelihood from their profession, and those 2% tend to work the majority of the time, according to surveys cited in a recent research by Queen Mary University of London (Simkins, 2019). The rest 98% seldom work at all. According to Rob Hardy (2013) of No Film School, "In the world of freelance filmmaking, where a good portion of your gigs will come from referrals, your reputation is your most valuable asset." In fact, Hardy informs us that in the unstoppable film business, to succeed, one needs to be successful.

The mainstream media or even scholarly journals have hardly covered this topic. Since the big deceit of the film industry is often apolitical, critical theorists are less inclined to focus on it. A select few win it all, so why are there so many losers? Don't more people not flip the table over? The explanation is straightforward: they believe that sometime, somehow, they will get their moment. There, they saw more potential for the game. The same might be said about the vast majority of movie reviewers who relentlessly criticise films but are less inclined to dismiss the whole casting process that results in an actor being cast in a part that they are not suited for. Marilyn Monroe, who is often recognised as the most beautiful actress of all time, described Hollywood as a "overcrowded brothel". Other actresses, like Shirley Temple, Judy Garland, Dame Joan Collins, Megan Fox, Dame Helen Mirren, Zoe Kazan, and many more, have acknowledged that factors other than skill or originality are used to choose actresses.

Fourth, the real mechanism that controls creativity is the industry's "carrot and stick" approach. Indeed, some individuals claim that "the fundamental processes of creativity, the pursuit of an artistic vision, and the passionate commitment to art that characterises art professionals—these things remain at the heart of what it is to be a practising artist" (Throsby & Petetskaya, 2017). We agree that this is true from the outside. However, in real life, everything is decided by studios that have spent tens of millions of dollars on a single film. The precise contracts that great filmmakers sign with studios assure that any suggestion made by the studio, and in especially by the sales department, will be carried out without hesitation. Studios take great care to prevent aspiring filmmakers from pursuing their creative aspirations. The most crucial thing is money.

There are exceptions, such as when Elizabeth Taylor in Cleopatra coerced 20th Century Fox into accepting her financial demands, putting the studio on the edge of insolvency. As a result, 20th Century Fox was compelled to replace Rouben Mamoulian as director with Joseph L. Mankiewicz. Many films, including Anchorman: The Legend of Ron Burgundy, Army Of Darkness, Blade Runner, Brazil, Clerks, Deep Blue Sea, The Descent, Dodgeball: A True Underdog Story, and Escape Room, to name a few, have had the entire crew called back after the film's production to shoot new scenes and alter the plot. Ironically enough, there is something known as the "director's cut," which is the version of the film that the filmmaker prefers. Movie fans may have to wait years before the director's cut is made available so they can see the "real" creative effort.

The voyage of the creative process is intricate and multidimensional, and it results in the creation of original concepts, works of art, inventions, and innovations. It has a key role in determining the cultures, economics, and personal lives of humans. This article will examine the creative process in detail, dissecting it into its essential phases and going through the numerous elements that motivate and impact creativity. Even though it is hard to properly capture the depth of the creative process in only 3000 words, this article will provide a detailed breakdown of all of its crucial elements.

Inspiration and the generation of ideas

Inspiration, a spark that lights the imagination, often kick starts the creative process. Personal experiences, views of the outside world, works of literature, art, music, and social interactions are just a few examples of the many things that might inspire. When anything prompts the mind to investigate, inquire about, or express itself, it is a time of enhanced awareness.

Personal Experiences:

Personal experiences are one of the most popular sources of inspiration. Our own lives provide a rich tapestry of subject matter for artistic inquiry, whether it be a moment of introspection, a life-altering experience, or a strong feeling.

World Observations:

Astute observation is another source of creativity. Finding new insights and creative ideas might result from paying attention to the little elements of the world around us. The natural and artificial environment often serves as a source of inspiration for scientists, authors, artists, and inventors. Literature, visual art, and music all have the ability to take readers or listeners to other worlds and arouse strong emotions. These artistic mediums often act as a source of original thought and interpretation.

Collaboration with others:

Working together with friends, coworkers, and mentors helps foster creativity. The synthesis of new thoughts and solutions is often facilitated by the exchange of ideas and viewpoints.

Reflection and Incubation

The creative process moves into the incubation phase after an initial concept or source of inspiration is found. The concept is subconsciously processed at this stage, enabling it to develop and grow. It is reflective and meditative during this incubation stage.

Processing in the Subconscious:

Incubation is greatly aided by the subconscious. It keeps working on the concept in the background, relating it to other ideas, events, and information.

Problem-Solving:

The incubation stage enables the investigation of possible solutions in situations when creativity is used to problem-solving. To come up with creative solutions, the mind may take into account many viewpoints and aspects.

Time and space:

Incubation could call for some separation from the original concept. This respite fosters new insights and avoids creative roadblocks.

Enlightenment and the Epiphany

The lighting stage is often characterised by an instantaneous "Eureka!" moment when the answer or inventive insight becomes obvious. It is characterised by a surge of enthusiasm and understanding and may be brought on by conscious or unconscious processes.

Serendipity:

Sometimes, apparently out of nowhere, creative breakthroughs happen by chance. These serendipitous encounters may occur from unanticipated encounters or accidental discoveries.

Problem-Solving:

When a problem has to be solved, illumination denotes the stage at which the answer becomes clear. Connecting facts or concepts that were previously unconnected may be necessary. Many artists claim to enter a "flow state" during the illumination stage, when they are totally absorbed in their work and ideas come to them without effort.

Assessment and Improvement

The creative process moves into a stage of examination and refining after the first spark and enlightenment. In this phase, the concept, undertaking, or invention is critically evaluated to ascertain its viability, efficacy, and scope for advancement.

Critical Thinking:

Critical thinking and creativity go hand in hand. It is crucial for the growth of the concept to assess its advantages and disadvantages. Multiple iterations are often used in the creative process. By making a number of tweaks and enhancements, creators develop their work, building on prior iterations. Feedback is important at this stage, so ask your friends, mentors, or the target audience for their opinions. External opinions may provide insightful suggestions and aid in the idea's continued development.

Feasibility and Viability:

Creativity often has to take into account practical factors like feasibility and viability. This evaluation guarantees that the original thought can be put into practise or realised in the actual world.

Execution and Implementation

It's time to implement or execute the creative concept after it has been improved and assessed. Based on the kind of creative endeavour, this stage varies greatly.

Artistic Creation:

For musicians, authors, artists, and other creative people, implementation entails actually creating the composition or piece of art. Technical expertise, workmanship, and commitment could be needed for this. Implementation in the context of innovation and invention entails the creation of prototypes for new goods, services, or systems. Collaboration, engineering, and problem-solving are often needed.

Entrepreneurship:

To become successful, company owners must transform their innovative ideas. Planning, funding, marketing, and strategic execution are all involved.

Impact on Society and Culture:

Some artistic endeavours have a significant influence on society and culture. Advocacy, social movements, or policy reforms may all be necessary to put these ideas into action.

Analysis and Recommendations

The creative process is cyclical, and it often requires continual analysis and criticism long after the final product has been produced. Creators may go back and review their work to determine its effect and think about making improvements.

Impact Assessment:

Authors assess how their work will affect them and the people it is meant for. They reflect on whether the objectives of their creative endeavour were met.

Continuous Improvement:

Creative people and businesses often practise continuous improvement. They utilise criticism and introspection to improve their work and pursue perfection.

Adaptation:

In a world that is evolving quickly, creative initiatives may need to adjust to brand-new conditions, tools, or client preferences.

External Influences and Factors

Even while the creative process is mostly an interior trip of the mind and imagination, it is also impacted by outside circumstances and influences. These outside circumstances have the power to either foster or stifle creativity.

Environment:

Creativity is greatly influenced by the social and physical environment. While a constrictive or hostile atmosphere may hinder creativity, the opposite is true as well.

Culture and Society:

Social expectations, cultural norms, and values may influence creativity. People and ideas tend to be more inventive in societies that appreciate and foster creativity.

Education and Learning:

By giving people the information, skills, and exposure to a variety of ideas, educational institutions and chances for lifelong learning may foster creativity [11], [12].

CONCLUSION

New tools and venues for production and distribution have been made possible by technology, revolutionizing the creative process. More individuals can now engage in creation since it has become more democratic. The creative process is an exciting and complex journey that starts with inspiration and ends with execution and reflection. It is a profoundly human endeavor that enhances our lives, influences innovation, and changes our societies. The phases of inspiration, incubation, illumination, assessment, execution, and reflection are often present in the creative process, even if each one is different. External elements including environment, culture, education, and technology also have a big impact on whether or not creativity flourishes. In the end, the creative process is proof of the unbounded capacity of human imagination and creativity, which is constantly profoundly reshaping our reality.

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