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CONSCIOUSNESS AND CREATIVITY IN ARTIFICIAL INTELLIGENCE

The Cognitive Side of Knowledge Management

JON-ARILD JOHANNESSEN

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The Cognitive Side of Knowledge Management

BY

JON-ARILD JOHANNESSEN
Kristiania University College, Norway

United Kingdom – North America – Japan – India
Malaysia – China

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INVESTOR IN PEOPLE

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INTELLIGENT ROBOTS: CAN THEY BE CREATIVE?

The key ideas in this book are:

(1) Discussing a new theory about uncovering hidden knowledge, which is assumed to be the area of knowledge responsible for the emergence of creativity and innovation.

(2) Reflecting upon a new theory about how intelligent robots can develop creativity.

(3) Systematizing and discussing three classes of algorithms: linear, evolutionary and systemic.

(4) Developing and reflecting on the concepts of synthetic consciousness, the synthetic 'I' and synthetic ethics.

(5) Developing and discussing the concept of integrated distributed consciousness in intelligent robots

INTRODUCTION

This introductory section outlines the two main themes of this book: creativity and consciousness. In this book we describe, analyze and reflect on creativity and consciousness in relation to intelligent robots.

We investigate two questions:

(1) Under what conditions can intelligent robots develop creativity? (Chapter 2)

(2) Under what conditions can intelligent robots have consciousness? (Chapter 3)

If we can develop intelligent robots, then we will have contributed to overcoming one of the most important restrictions on the innovation economy, namely the development of ideas and innovations. Ideas and innovations come from the underlying phenomenon of creativity.

If we can say something about consciousness and intelligent robots that can be applied in practice, then we will have contributed to the process of reflection on the question whether intelligent robots can think, or at any rate what sort of thinking this might be.

In the following section, we provide a brief introduction to the two themes of this book: creativity and consciousness in relation to intelligent robots.

CREATIVITY

Some Reflections on Future Competences

Some commentators say that in the future we will need people who can think creatively (Robinson, 2011). Would not the best solution be to produce intelligent robots with a creative potential that all of us could benefit from, in addition to human creativity? If we could develop creativity in intelligent robots, then there is a high probability that this could be a driving factor in the innovation economy (Johannessen, 2021).

Creativity is important for individuals, organizations and societies. As we stand at the threshold to the Fourth Industrial Revolution, creativity is perhaps the most crucial factor for ensuring that as many people as possible will benefit from development and welfare.

Of course, creativity is not a new phenomenon. It is at least as old as the invention of the wheel or of fire. What is new is that we are in an era where the phenomenon of creativity is not only important in the realms of art and technology but also in the everyday lives of the majority of people.

Creativity has become an increasingly important paradigm in politics, culture, technology and economics (Robinson, 2011). Our hypothesis is that creative intelligence will be the driver of the innovation economy. In addition to creative competence, we hypothesize that competence in change, technology, communications, team-working and cooperation will be crucial for individuals, organizations and societies at the threshold of the Fourth Industrial Revolution (Johannessen, 2022).

Creativity is not only about seeing and understanding the world we encounter, but it is also about creating the world we want to encounter. As a general rule, major upheavals throughout history have occurred as a result of new ideas, which went on to become innovations. Why shouldn't such ideas come from intelligent robots? Or, to slightly lower our expectations, from interaction between humans and intelligent robots?

Today's school and higher-education systems are designed to tackle the problems and challenges we encountered during the First, Second and Third Industrial Revolutions (Johannessen, 2019). At the threshold to the Fourth Industrial Revolution, our school and higher-education systems need to be redesigned to equip us to resolve the problems and challenges we will face when singularity occurs. In general, the competences we require are STEM competences.[1] These include competence in the coding, development and application of the three classes of algorithms that we describe and analyse in Chapter 3, together with an understanding of complexity and, not least, ways of reducing complexity. In addition, it is important to understand the knowledge domains underlying creativity, which we refer to in this book as hidden knowledge.

In light of the above discussion, we can draw a distinction between necessary and sufficient competences in the Fourth Industrial Revolution, i.e. the epoch when intelligent robots and artificial intelligence will constitute the future of working life (Fig. 1.1).

Necessary competences: STEM competences

Sufficient competences: 4C competences[2]

Of course, we are not suggesting that we should throw out the baby with the bathwater as part of this redesign process. We should bear in mind the following analogy, which is based on driving a car. If you only look at the road in front of you, you risk having another vehicle crash into you from behind. So if you fail to look in the mirror, you risk ending up in a ditch. If you engage in a dynamic process of looking in front of you, in the mirror and down at the dashboard, then it is highly likely that your journey will be safe. This analogy can be understood as suggesting that the competences needed in the Fourth Industrial Revolution can be divided into necessary competences and sufficient competences, as described more specifically above.

1 STEM stands for science, technology, engineering, mathematics.

2 The 4C competences are: creativity, change, communication, cooperation.

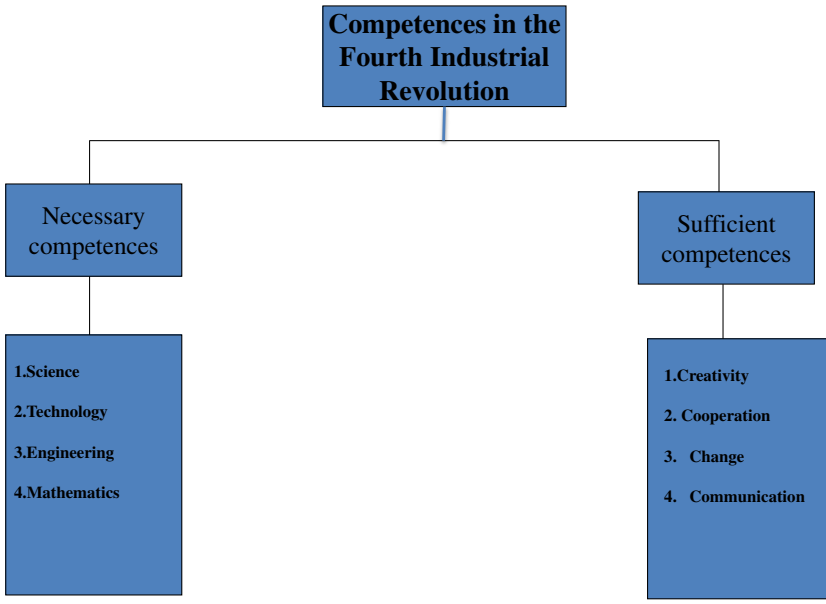

Fig. 1.1. Future Competences.

INTELLIGENT ROBOTS, CREATIVITY AND HIDDEN KNOWLEDGE

Being creative can be described as a process of abstraction (Robinson, 2011, pp. 6–24). In this abstraction process, the parts and the whole are included in an emergent element, over and above the sum of the individual elements (Corradini, 2013; Kim, 1999). This book builds on this assumption about creativity.

We also assume that when people have work which they like, have a burning desire for, master and want to be really good at, and when they have worked for an extended period within the field, they will be able to gain access to hidden knowledge (Kirzner, 1976, 1985). In this way, creativity can be developed and the new that has not been seen in the world before can be developed. Of course, intelligent robots cannot produce creativity in this way. On the other hand, they are logical, rational machines with an extremely large memory function, and can, as informats, be connected to areas of knowledge and to other informats around the globe. Therefore, they can create the innovative and new using the creative strategies, methods and techniques that are described in Appendix 1.

Intelligent robots and informats can create the innovative new by using creative strategies, methods and techniques. Furthermore, we assume that

intelligent robots will be in contact with hidden knowledge through the network of informats around the globe, to which they are connected.

Creativity is not the sole preserve of so-called creative people, nor are intelligent robots excluded from being creative. When Robinson (2011, p. 140) says we humans have something that separates us from all other living organisms on the planet, I presume he wasn't thinking of intelligent robots. What sets humans apart from every other living organism is our ability to envision a future, which enables us to use our creative powers to create that envisioned future. Yet, why shouldn't intelligent robots also be able to imagine a better future for humans? They have access to huge amounts of data and can identify patterns and trends in these data, better than most humans can. They can 'see' what is going to happen in future scenarios because they are able to compute many critical variables. They can also create an image of a desired future by assessing the necessary conditions and ideas that people develop. Consequently, in this way, intelligent robots and informats will be able to launch a vision of a desired future. Possibly, they will be restricted by some people or by the interests of some people, but this also applies to people. The point here is that intelligent robots can envision ideas of a future based on patterns and trends in patterns.

Intelligent robots and informats will be able to envision a future based on access to data and pattern development in these data, as well as on the ideas developed by human decision-makers. Intelligent robots can thus create the innovative new that must exist in order to develop the desired future.

Ideas and conceptions of future scenarios are what drive creativity forward. However, they are distinct phenomena, even if they are linked. One can say that in order to create the innovative new one needs some necessary preconditions, such as ideas and conceptions, as well as some sufficient preconditions that are the creative processes. However, creative processes can be considered first, because it is through creative processes that ideas and conceptions of future scenarios then develop. Therefore, it might be said that there is a circular and systemic interconnection between ideas, conceptions and creative processes.

Ideas and conceptions fuel creative processes. Creative processes, such as creative strategies, methods and techniques (which are described in Appendix 1), can also be used to enable intelligent robots and informats to create ideas and conceptions.

We make a distinction between creative processes (cf. Appendix 1) and creative output. At the same time, we also make a distinction between ideas, conceptions and creative processes. We have shown these distinctions and processes in Fig. 1.2.

Both humans and intelligent robots can imagine and envision things that exist and things that don't exist, using the strategies, methods and techniques of Appendix 1. For instance, a boat with wings that can fly; a submarine with wings that can fly, etc. Such conceptions are based on existing objects. Further, imagine a doctor boarding a submarine and the submarine being transformed into a nano-submarine, which is so small that it can enter the human bloodstream. The doctor in the submarine will then be able to carry out checks and perform operations within the veins and arteries of the person. Developing this imagined scenario further, we can imagine that the 'doctor' is actually an intelligent informat. Both people and intelligent robots are capable of envisioning such scenarios by using creative processes (cf. Appendix 1). In other words, what we are attempting in our explanation here is to claim that creativity is not just a human activity but also something that intelligent robots and informats will be capable of once they have access to certain creative strategies, methods and techniques. Through the various conceptions, we can envision various future scenarios, given different changes to some key variables. These future scenarios can best be schematized by intelligent robots and informats because they have more access to the necessary capacities to perform the calculations efficiently.

To review the above description, creativity is not something that is reserved solely for humans, but instead may also be developed in the future by intelligent robots and informats. This is a key assumption in this book. This assumption is elaborated on in Chapter 2. The premise is that these robots possess all three classes of algorithms, which are described in Chapter 3, as well as having access to creative strategies, methods and techniques.

Being able to envision the future lifts us out of our present moment, enabling us to develop innovations that haven't been seen in the world before. However, we're not talking about science fiction here, but about ideas and being able to envision future scenarios that in turn facilitate the creation of the

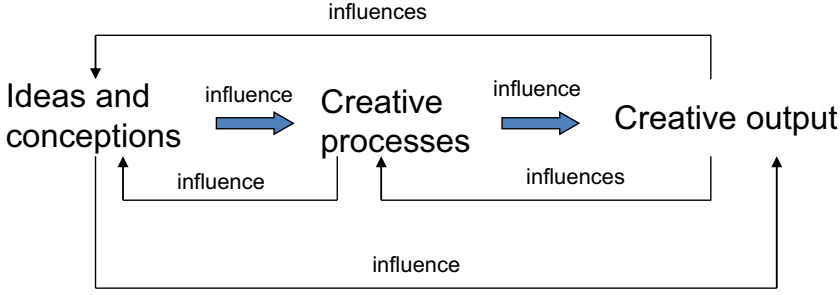

Fig. 1.2. Distinctions Between Ideas, Creative Processes and Creativity.

innovative and new, by taking as our starting point the opportunities we have in the present. The envisioning of a different future is thus a way of transforming the present into a better future. In this book, we are of the opinion that in the future intelligent robots can be used to both envision future scenarios, and also to calculate the various aspects of such future scenarios.

After being able to envision a future scenario, the process that leads to the creative new as a concrete opportunity will be implemented. This is where we will be very dependent on the capabilities of the intelligent robot. The reason is that humans may have better creative ability in being able to envision the future, but the intelligent robot will definitely have better computational capabilities. The intelligent robot will be able to assess different future scenarios and assess the various aspects of these future scenarios. It will be able to do this more effectively, faster and more precisely and reliably than a human. The creative person and the creative robot do something about their ideas and conceptions: they act to implement them.

Creativity without action is like a fish out of water, there will be no headway, and the fish as creativity will most probably die. The intelligent robot can, for example, be creative and carry out calculations in mathematics, science and engineering and envision future scenarios within these fields; for instance, they will be able to envision what might happen if the ice on the North Pole and Greenland melts. Creativity and creative actions are not only limited to art but also span the full range of areas that humanity is concerned with.

Just as ideas are not innovation, imagination is not creativity. In both cases, innovation can only manifest itself through action.

People and intelligent robots can develop a common awareness of an imagined future through creative processes. However, the creative person or robot does not just develop ideas out of thin air, they usually have their origin in a purpose. The purpose is often related to a problem or phenomenon. The aim will be to solve the problem; the problem or phenomenon should first be understood and explained. To avoid sheer chaos when the intelligent robot is creating ideas, the robot will need to have an integrated feature that selects the most fertile ideas that will most likely solve the problem or be able to explain the phenomenon that is in focus. We have shown this creative process of both the creative robot and the creative person in Fig. 1.3.

Creativity, understood in this way, is a process that can use creative strategies, methods and techniques, such as those shown in Appendix 1. At the same time, creativity in this context means that original innovation will result from this process. In addition to this, it is crucial that the creative product has value for someone or something. In order for it to be of value to someone, the mechanisms that select and deselect ideas must be embedded in the creative

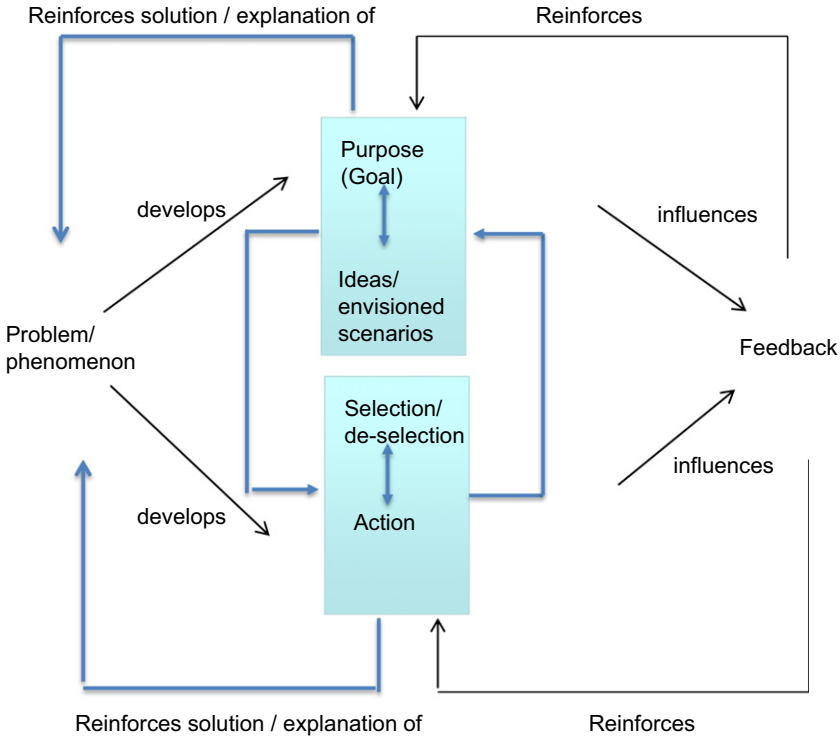

Fig. 1.3. Creative Process of an Intelligent Robot and the Creative Person.

process; this is shown in Fig. 1.3. At the same time, the purpose of the process must be clear and unambiguous, i.e. the creative process should be planned and controlled, and based on a problem, challenge or phenomenon. We are not concerned here with ideas that suddenly appear from out of nowhere and then change the whole world. Such creative ideas are also of great interest, but it is not these that we will examine in this book. Intelligent informats that have access to the available knowledge globally within their field, and which have all three classes of algorithms at their disposal (described in Chapter 3), will also be able to carry out planned creative processes.

The planned creative process, performed by humans and intelligent robots, creates something that has not been seen in the world before and which has value for someone or something. People often make mistakes in the creative process; that is, that which is created is not new, nor does it have any value to someone or something. Informats will also commit the same errors. However, it is in making mistakes that the foundation is laid for creating innovation that has value because learning is the result of errors and feedback from these errors.