Creative Potential Through Artificial Intelligence: Recommendations for Improving Corporate and Entrepreneurial Innovation Activities

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Abstract:

This article shows how the creative performance of start-ups or established organizations can be improved through the use of AI-based systems for actively promoting creative processes. With insights from two studies conducted with entrepreneurs, innovation managers and workshop facilitators, we provide recommendations for companies and entrepreneurs on the ability of AI to support creative potential to remain innovative and marketable in the long term. Our studies cover aspects such as AI for entrepreneurial activities or creativity workshops and show how to make use of AI-based systems to enhance the creative potential of the person, the process or the press (environment). Our findings also provide theoretical insights into the perception of AI as an equal partner and call for further research on the design of AI for the future creative workplace.

Keywords: Artificial Intelligence, Creativity, Idea generation, Innovation, Entrepreneurship.

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1 Introduction

In an increasingly networked world, the demands on companies and start-ups to retain existing customers and acquire new ones, as well as to secure market shares, are growing. Digitization poses enormous challenges for companies but holds the potential for organizational transformation (Wessel, Baiyere, Ologeanu-Taddei, Cha, & Blegind-Jensen, 2021). A key factor in this challenging environment are innovations, which can create competitive advantages and ensure sustainable success (Flynn, Dooley, O'sullivan, & Cormican, 2003; Weerawardena & Mavondo, 2011). Therefore, companies and organizations need innovative products and services as well as novel and adequate methods for their development to respond to dynamic changes in markets and customer needs (Amabile & Pratt, 2016; Somech & Drach-Zahavy, 2013). Not only established companies need to innovate constantly, but also young companies and start-ups trying to enter the market with new products or services. Particularly against the backdrop of global crises such as the Covid-19 pandemic, digitization leads to a change in needs and values that requires disruptive and creative solutions (Azoulay & Jones, 2020; McMullen & Shepherd, 2006). Therefore, it is especially vital to be innovative and to produce new and innovative ideas as quickly as possible in order to stand out from the competition.

Creativity is considered a decisive factor for generating ideas and developing novel products and services (Amabile & Pratt, 2016; Gassmann & Zeschky, 2008). Creativity has been recognized as a critical factor directly influencing organizational success (Amabile, 1988; Gabriel, Monticolo, Camargo, & Bourgault, 2016). Researchers are confident that improving creative performance is key to overcoming external tensions, promoting novelty, and producing innovation (Amabile & Pratt, 2016). This is true for countless professions and businesses, as innovation is set in motion by creative performance (Paulus, Dzindolet, & Kohn, 2012). To produce valuable innovations, both startups and established companies need to pay more attention to supporting creativity (Shalley, Gilson, & Blum, 2009).

Nowadays, information technology (IT) is used to shape the way creativity is supported (Gabriel et al., 2016; Massetti, 1996; Wang & Nickerson, 2017). Computers and software systems are designed and implemented to systematically support various tasks and processes of creativity, in which specific mechanisms and functionalities are used to enhance the creative outcome (Gabriel et al., 2016; Wang & Nickerson, 2017). However, the possibilities that IT offers are not yet thoroughly exhausted, and the way computer systems can enhance creativity are yet to be examined and developed as IT constantly evolves and new forms of support emerge (D. Cropley, Medeiros, & Damadzic, 2021; Gabriel et al., 2016; Wang & Nickerson, 2017).

Recent advances, due to an enormous increase in computing power and also to novel algorithms and methods (Ransbotham, Gerbert, Reeves, Kiron, & Spira, 2018), have brought artificial intelligence (AI) back into public awareness and research interest. AI offers companies new possibilities to innovate products and services or to further refine existing ones (Brynjolfsson & Mcafee, 2017; von Krogh, 2018). In addition, AI has the potential to change organizational processes and even disrupt entire business models. As a result, companies in all industries are currently investing in the development of AI capabilities (Ransbotham, Kiron, Gerbert, & Reeves, 2017). Not only IT-companies such as Google, Apple or Facebook focus their corporate strategy and investment planning on the use of AI, but also non-tech companies, as well as small and medium-sized enterprises, are pursuing a strategy that requires the approach of AI (Ransbotham et al., 2018).

However, most methods such as machine learning are used to process natural language or classify large amounts of data, thereby generating added value (von Krogh, 2018). The huge amount of data generated by business activities and its permanent availability led to investments in AI technologies. A large part of this is the investment in powerful and almost unlimited scalable computing capacities, which are considered the essential basis of AI procedures (von Krogh, 2018). Furthermore, the high number of available services makes it seemingly easy for companies to integrate AI into their business processes. This is why common software for AI applications such as Google's Tensorflow or IBM's Watson are (partially) freely available, and hardware is used flexibly via cloud platforms such as Amazon Web Services (AWS) or Google Cloud. Even though companies have already recognized the potential of AI for their business model and have started to use it, there are many other areas where AI can be applied.

In addition to the missing know-how, established companies with a traditional business model and small and medium-sized companies often face the question of how to create added value by using AI (Ransbotham et al., 2017). Here, the often-limited view on the hyped technology of AI plays an essential role. CIOs and managers equate AI with the analysis of large amounts of data, with intelligent robots or fast

optimization procedures, but they overlook AI's further potential (Ransbotham et al., 2018). In this context, AI methods' hold potential, e.g. natural interactions with digital assistants and its benefits from this interaction (Maedche, Morana, Schacht, Werth, & Krumeich, 2016). In this case, another aspect is the limited view on possible applications of AI in knowledge-intensive internal business processes (Liebowitz, 2001). An often overlooked field of application is innovation management and, more precisely, the support of creative processes in companies (Colton & Wiggins, 2012). The sheer potential of AI in the area of creative processes can and should be used by companies to strengthen their innovative power, to bring novel products and services to the market and thus remain constantly competitive (D. Cropley et al., 2021).

In recent years, there has been an increased appeal for research in the area of collaboration between humans and AI (Mirbabaie, Stieglitz, Brünker, et al., 2021; Mirbabaie, Stieglitz, & Frick, 2021; Seeber et al., 2019, 2020; Siemon, Li, & Robra-Bissantz, 2020; Siemon, Strohmann, & Robra-Bissantz, 2018). This has resulted, for example, in the 'Machines as Teammates Research-Agenda', which calls for further research in the area of artifact design and collaboration design (Seeber et al., 2019). Among other things, it lists how AI could be used in future, when a team's tasks and work practices should be taken over and practiced by AI (Seeber et al., 2019). A research panel held at the European Conferences on Information Systems in 2019 also discussed how AI can be used beneficially in future human-AI collaboration scenarios (Seeber et al., 2020). Among other things, the analytical capabilities of AI, which are relevant in the area of knowledge and learning, were addressed, as well as the support in decision making. Aspects of creativity, however, are only mentioned in passing in both articles. The research agenda by Seeber et al. (2019) points out that AI is already used to generate creative solutions autonomously. However, they raise the question of the extent to which this autonomous creativity could limit that of humans. Although there is already much research in the area of autonomous generation of ideas by AI (e.g., in the area of computer science and specifically computational creativity), research in the area of information systems where humans interact with AI to go through creative processes is still under-researched (Boden, 2009; Colton & Wiggins, 2012; Lubart, 2005; Seeber et al., 2019; Siemon et al., 2018).

Thus, the objective of this study is to address the question: "How can AI be used to increase creative potential in organizations?" To answer this question, we first depict possible aspects in the creative process that have the possibility to be supported and identify existing studies and approaches that specifically support creativity by using AI-based systems. Furthermore, we report the results of two conducted studies focusing on selected aspects of AI supporting creative processes and conclude with eleven approaches, i.e. specific suggestions for implementing AI for creativity support. With the results of our two studies, we show how AI-based systems can enhance the creative process, the person's or group's creativity, and the creative environment (press) to consequently increase creative potential. In doing so, we were able to contribute to theories about the interplay between people, creative challenges (tasks) and technology, namely AI. Organizations and entrepreneurs can build on our recommendations and explore which of the many manifestations and forms of AI (e.g. conversational agents) can be applied in creative processes.

2   Artificial Intelligence and Creativity

Creativity is a valuable human characteristic that gives people the ability to create something new or original and yet useful (Boden, 2009). Creativity is regarded as a driver of innovation, ensures corporate success and is thus a basic requirement for a flourishing economy (LeBel, 2008; Wong, Ho, & Autio, 2005). Companies have recognized the value of creativity to generate innovative products or services early on (Amabile & Pratt, 2016). Especially when it comes to solving complex problems or improving processes, creativity is a fundamental resource (Amabile, 1988; Amabile & Pratt, 2016). Therefore, organizations and companies try to support their employees as well as external stakeholders in providing creative outcomes. Dedicated departments that ensure systematic innovation management promote creative potential, both within the organization and outside the companies' borders (Chesbrough, 2013; Flynn et al., 2003). In an analog context, this is predominantly achieved with the help of creativity workshops and facilitators, while in a digital context, IT is used to design systems that support creative processes. These systems aim to support the creative process further by using different mechanisms and functions that IT offers (Gabriel et al., 2016; Massetti, 1996; Wang & Nickerson, 2017).

As creativity is an intangible term associated with an outcome of a process (product), a person or a group, a process itself or an ability or way of thinking, the way creativity is supported varies greatly (Hennessey & Amabile, 2010; Rhodes, 1961). Rhodes (1961) defined these four distinct aspects of creativity (i.e., person, product, press, and process) that influence the occurrence of creativity and are the essential cornerstones

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for any kind of creativity research. This creativity model still serves today to show where the creative potential lies and explain how to support creativity (Gruszka & Tang, 2017).

Creativity is an activity that is heuristic and implies that a process is required to develop an idea, i.e. the creative outcome, also called product (Hennessey & Amabile, 2010; Runco, 2004). This process includes various ways of thinking, in which fragments are created, associations are formed, several aspects of an idea are created (divergent phase), fragments are merged, and ideas are combined (convergent phase) (Basadur, Runco, & Vegaxy, 2000; Runco, 2004). Since the creativity process consists of both divergent thinking and convergent thinking, different support approaches are essential. For example, in the divergent phase, methods or systems help form associations or allow mental leaps (Basadur et al., 2000; Brophy, 2001; Hocevar, 1980; Holyoak, 1996). In the convergent process, support is needed to recognize patterns and summarize aspects (Brophy, 2001; A. Cropley, 2006). Furthermore, the person or group involved in the generation of the idea is supported by providing beneficial input, as well as creative abilities. As the environment (press) in which the process takes place significantly impacts creativity, it also encompasses various supporting features, such as external creative stimuli (Amabile & Gryskiewicz, 1989; Fink et al., 2012). Finally, the product, namely the creative outcome, is the aim of every creative process. To have the best outcome possible, it is important to support the person, the process and create a creativity-enhancing environment (Dean, Hender, Rodgers, & Santanen, 2006; Rhodes, 1961). Figure 1 shows an overview of all four aspects of creativity.
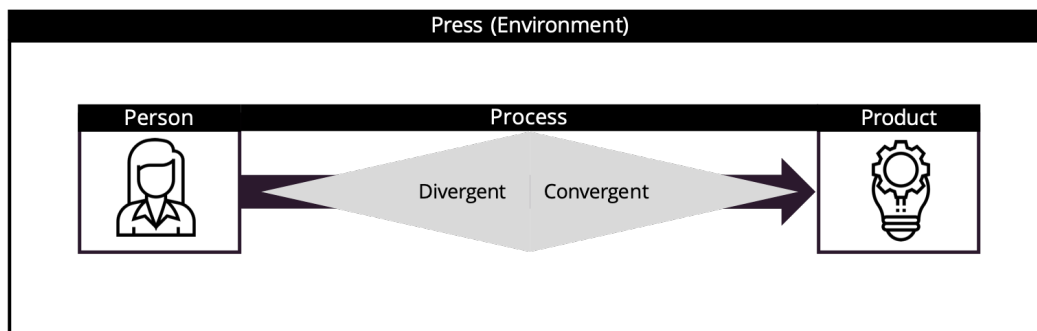

Figure 1. Aspects of creativity

With the rise of AI, systems become more intelligent and capable of either actively supporting specific creative tasks or generating creative outcomes. In the proposal that led to the famous Dartmouth conference, often considered the birth of AI, the term creativity was mentioned, among other things, as a key goal of AI (Boden, 2009; McCarthy, Minsky, Rochester, & Shannon, 2006). Although many researchers see creativity as something intangible and even mystical (Boden, 2004), others see creativity as something systematic and explainable, which means that "computers can- and do- exhibit the same kinds of behaviors that creative humans do" (Colton, López de Mantaras, & Stock, 2009, p. 12).

The focus in the field of computer science is often on the development of modern algorithms, such as artificial neural networks, which generate novel ideas without the influence of humans (Colton & Wiggins, 2012). To this day, AI has been able to compose music (Cope, 2015; De Mantaras & Arcos, 2002), perform visual and artistic art (Cohn, 2018) and write linguistic work such as poems and novels (Liu, Fu, Kato, & Yoshikawa, 2018). In addition, creative decisions in filmmaking (Elson & Riedl, 2007; ScriptBook, 2018) or other organizational fields were performed by AI-based systems (Aleksander, 2017; Anderson, Rainie, & Luchsinger, 2018; Schwartz, Hagel, Wooll, & Monahan, 2019). One of the leading researchers in computational creativity, Margaret Boden, argues that research on computational creativity helped towards a better understanding of creativity and that combinatorial and transformational exploration can be performed by computers (Boden, 2009). Creating a system that has the ability to compose a new piece of music, for example, affords a better understanding of the procedures of a human brain that are necessary to perform such a creative task (Widmer, Flossmann, & Grachten, 2009). Consequently, computer scientists, and more specifically researchers in the field of computational creativity, are concerned with how AI has the ability to generate creative outcomes (product) independent of human influence.

The area of information systems considers socio-technical systems, i.e. the interplay between people, tasks and technology. If humans are to solve creative tasks with the help of AI (technology), AI takes on a role in which it actively interacts with humans. In this context, AI might act as a mediator or arbitrator to dispute resolutions or solve problems (Larson, 2010). Other AI-based systems jointly work with humans and

evaluate their written ideas according to their novelty and applicability to the given problem (Maher & Fisher, 2012). Combining the power of AI with human creativity, "the complementary strengths of human intelligence and AI" (Dellermann, Ebel, Söllner, & Leimeister, 2019, p. 637) in a so-called hybrid intelligence results in better performance than the separation of those two. Such as the involvement of AI as teammates, where humans and AI-based systems jointly work together to solve a creative task (Randrup, Druckenmiller, & Briggs, 2016; Seeber et al., 2019; Siemon et al., 2020). Dellermann et al. (2019) discuss two different views in which analytical AI extends intuitive human intelligence. Hybrid intelligence means not only that human intelligence is augmented by AI but also that AI is augmented by human intelligence. The authors refer to these two approaches as artificial intelligence in the loop of human intelligence and human intelligence in the loop of AI (Dellermann et al., 2019). Their approach clearly shows the difference between research in computational creativity, where hybrid intelligence is not pursued, and research in information systems, which always involves considering and interacting with humans.

3 Creative Potential through Artificial Intelligence

Due to the complex nature of creativity, creative potential resides in many aspects and can be supported in various ways. In addition to systematic but oftentimes passive support through existing tools to support creativity (Gabriel et al., 2016; Wang & Nickerson, 2017), AI-based systems have the potential to actively participate in creative processes (Anderson et al., 2018).

Lubart (2005) divided the support provided by an IT-system into four categories and figuratively named them: Computers as a nanny, as a pen-pal, as a coach or as a colleague. The nanny supports by monitoring the creative process, setting agendas and deadlines. The pen-pal helps by providing the possibility to receive, compose and distribute an idea; the coach represents a support system that helps with a specific method or with the system itself, e.g. by recommending other methods or steps within idea generation, and the computer as a colleague depicts an AI-based system that actively takes part in a creative process (Lubart, 2005). Lubart et al. (2005, p. 368) argue that "it is possible to conceive of computers as real partners in the creative process intervening at different points in order to generate, evaluate, or refine ideas and bring them to full-fledged products." What initially began as theoretical derivations and models is now possible (Besold, Schorlemmer, & Smaill, 2015; Boden, 1998; Colton & Wiggins, 2012). Abilities that could initially only be attributed to humans, are now to some extent be performed by AI (Besold et al., 2015).

The field of computational creativity focuses on the aspect in which IT independently creates creative products without human influence and interaction, while information systems consider the interplay between people, tasks and technologies. Therefore, AI-based systems that autonomously achieve creative results without human interaction are part of computer science and therefore not the focus of our research. However, researchers in IS argue that "humans and computers have complementary capabilities that can be combined to augment each other" (Dellermann et al., 2019, p. 4). Concepts such as hybrid intelligence, human-machine symbiosis or human-in-the-loop argue that superior results are accomplished when combining the capabilities of humans and AI in a mutual value generation by continuously learning from each other and improving each other (Dellermann et al., 2019; Gerber, Derckx, Döppner, & Schoder, 2020). In the context of creativity, this means humans and IT (in this case, AI-based systems) work together on a creative task and thus increase the overall creative potential.

Due to the various aspects of creativity and the resulting support possibilities, it is important to create an overview of the potential of AI-based systems to fundamentally support creativity. According to Figure 1, we identified four aspects where AI may contribute to support creativity:

Person: The person or the group are essential parts of creativity, as they possess most of the creative potential. Creativity is shaped by experience, skills and thinking behavior which can be trained and developed (A. J. Cropley, 1999; Rhodes, 1961).

Press (Environment): The environment involves all aspects within the surrounding context of the individual or the group. Entities within the environment can provide input that stimulates the person or group to enhance or even impair the creative performance (Amabile, 1988; Rhodes, 1961).

Process: The creative process involves all fundamental heuristic actions that are conducted to create a novel idea. It involves various activities and can be divided into two distinctive ways of thinking (Basadur et al., 2000; Rhodes, 1961):

Process - Divergent thinking: Divergent thinking is a thought process used to generate creative ideas by exploring many possible solutions (A. J. Cropley, 1999; D. H. Cropley & others, 2019; Hocevar, 1980).

Process - Convergent thinking: Convergent thinking is a thought process that follows a particular set of logical steps to arrive at one solution (Akbari Chermahini & Hommel, 2012; Brophy, 2001).

Product: All aspects lead to one or more creative outcomes, the idea or ideas that become embodied into a tangible form, referred to as the product (Runco, 2004).

The product can either be created autonomously by AI, which is researched in the field of computational creativity or computer science, or it can be the result of a process between humans and technology (AI), which is researched in the field of information systems. As mentioned before, research in information systems considers socio-technical systems that address specific tasks through an interplay between humans and IT. Creative outcomes, i.e. the autonomously created product generated by AI, without the influence of humans, are therefore part of the research in computer science or computational creativity (Colton & Wiggins, 2012). In our research, we consider information systems, i.e. AI in the interplay between humans, to perform creative tasks. Therefore, the creative outcome, i.e. the product, is always a collaborative effort between humans and AI, hence a hybrid effort. In this paper, we look at socio-technical aspects in which AI could be used beneficially, thus leaving the product out of the equation.

Building on this, we conducted two studies to gain more detailed insights into potential support by AI-based systems for the creative process, person and press. Contrary to the rapidly evolving body of literature concerned with generative AI-based systems that create new or even novel products based on existing samples and data, we focus on the potential effects of AI-based systems on human creativity. The results will be used to identify further support possibilities and to classify them accordingly.

In our studies, we look at two different scenarios that provide insights and implications for the use of AI-based systems in creative processes. We report the results of two different studies, in which an AI-based system takes on the role of (1) a creative assistant for entrepreneurs and (2) a creative assistant for creativity workshops. All studies involve participants working in established companies or as entrepreneurs in start-ups and report their perception and expectations towards the creative support and joint work with AI-based systems. We report and discuss our findings of the studies and conclude with insights, implications and recommendations for companies and start-ups. We aim to identify requirements for the successful implementation of AI in creative processes to derive then recommendations for organizations, entrepreneurs and designers of AI. By using different levels of organizations to study how they would perceive the supporting element of AI in their creative processes, we strive to generate comprehensive, diverse and therefore transferable knowledge. From our findings, it is clear that all levels of the organization foresee the impact of AI and its feasibility. Unlike earlier research, which states that organizations often have a hard time adjusting to technological changes, our paper contradicts the general perception. It suggests that AI has the opposite effect, as people on all organizational levels see how AI may profit them, whilst they also recognize its limitations.

4 Study 1 - AI as a Creative Assistant for Entrepreneurs

The aim of the first study is to examine the potential of an AI-based creative assistant to support entrepreneurs at an early stage of their business as well as in their daily business. Creativity is proven to be fundamental for the early stage of start-ups, as well as in the entire entrepreneurial process (Siemon, Narani, & Robra-Bissantz, 2017). However, especially in their daily business, entrepreneurs often struggle to harness their creativity due to the many tasks an entrepreneur has to cover (Oosterbeek, van Praag, & Ijsselstein, 2010). For this reason, we investigate to what extent a creative assistant has the ability to foster creativity for entrepreneurs. We chose to interview experts as a qualitative method to explore practical and specific knowledge based on professional activities. Expert interviews have grown in popularity as a reliant method to obtain knowledge that is otherwise hard to discover (Bogner, Littig, & Menz, 2009). Overall, six entrepreneurs were acquired with diverse business activities from different branches. The first entrepreneur (female) is the founder of a concept store and online shop for interior, fashion and plants. The second entrepreneur (male) is the co-founder of an IT start-up that wants to support the initiation phase between retailers and customers with an AI-based mobile application. The third entrepreneur (male) is the co-founder of a creativity and Design Thinking Agency, conducting workshops and teaching how the Design Thinking Mindset is used to establish a new culture of innovation in organizations. The fourth entrepreneur (female) is a Professor for Entrepreneurship and founder of a consultancy helping small and medium-sized companies to write grant applications. The fifth and sixth entrepreneurs are two graphic designers (both female), who deal with the creative design of advertising media.

4.1 Procedure

A semi-structured interview guideline was developed based on prior experience and literature concerning entrepreneurship (Reis, 2011; Ward, 2004) and virtual assistants (McTear, Callejas, & Griol, 2016). The interview guideline consisted of closed- and open-ended questions, accompanied and extended by questions to immerse with the thoughts and views of the entrepreneurs. Aspects of the interview guide were the company's presentation, the challenges they face as an entrepreneur, the importance of creativity in their work, and the discussion of potential support from AI as a creative assistant.

The interviews were conducted between 18th April 2018 and 18th November 2018 and took between 37 and 74 minutes. After conducting the interviews, they were transcribed and coded in MAXQDA version 18. The interviews were analyzed using codes as an efficient data-labeling and data-retrieval device (Miles & Huberman, 1994). Coding was done inductively by three researchers, recognizing and grouping different patterns in the text. After a first round, the individually created codes were discussed in the group to find consensus. This process was repeated after each coding round to obtain different perspectives on the qualitative data and consequently to unify and merge them into a common understanding.

4.2 Results

The interview coding revealed several insights into the potential support of entrepreneurs by an AI-based creative assistant. All interviewees mentioned that the problem is often not the lack of creativity but the freedom to implement the solutions due to many other tasks they are obliged to do. Other problems are, for example, conducting creativity methods, managing ideas or sharing them within their team. To prepare the entrepreneurs mentally for the topic, the possibility of active support by AI-based systems was derived from already known systems such as Apple's Siri or Amazon's Alexa. Since all participants had already gained experience with these systems, they could imagine the human way of interacting with a machine. This thought was continued with the assumption that with further technological progress, the potential and functionality of AI-based systems will also continue to evolve. After this introduction, the entrepreneurs were prepared to discuss the possibilities of such solutions. One potential aspect that emerged from the discussions was an AI-based support for idea management. Since entrepreneurs are generally very creative people (Ko & Butler, 2007), many ideas emerge that require intelligent processing and management (process, convergent thinking). At times and places where further development is difficult ("The best ideas always came to me when I was somewhere, I didn't actually think about it, like under the shower."), an AI-based system could help capture ideas, initially evaluate them and put them into context (process, divergent thinking, convergent thinking). Good ideas often emerge uncontrolled and are therefore often forgotten or discarded and not further followed. At this point, an AI-based system could collect those ideas, proactively structure, process and remind the entrepreneurs to deal with them later. Moreover, the AI-based system should foster creativity with a proactive behavior by reminding for pauses or creative sessions (process), and helping to conduct creativity methods (person, process). Recognizing when a creative process should be triggered or an entrepreneur should use creative activities might also be supported by an AI-based system (person, process). In addition to direct creative support, the system could also provide information for a start-up project and support the entrepreneurs in their respective business phase (process, convergent thinking).

4.3 Implications

In summary, it can be said that entrepreneurs would consider the support of an AI-based creative assistant and would have highly benefited from its use. A creative assistant could create space for creative time (press, process and person) and actively help collect and structure ideas and support to transform them into a minimum viable product (process). All entrepreneurs agree that this must be done in a safe and reliable way. A creative assistant is especially interesting for entrepreneurs who want to start or have started a business on their own to have a partner but also for teams to coordinate between the individual members. These results apply equally to internal start-ups and spin-offs from existing companies, where entrepreneurs are subject to similar conditions. Table 1 summarizes the results and depicts the creative potential through AI support. The contribution of the study is discussed and summarized in section "Implication and Contribution", along with the results from the second study.

Table 1. AI as a Creative Assistant for Entrepreneurs

Creative potential

Person: Foster creativity through proactive behavior, enhance the exchange of ideas within a team, capture brainwaves (creative moments), trigger creative activities
Press: Create free space for creativity, foster a creative atmosphere tailored to the entrepreneur
Process (general): Remind for pauses and creative sessions, help to conduct creativity methods, automated idea storage, identify idle times, idea management (collecting ideas, reminding of ideas, helping to conduct brainstorming)
Divergent thinking: Autonomously collect information concerning the business idea, stimulate creative thoughts
Convergent thinking: Support the selection of ideas to continue, initial idea evaluation, support the process of bringing an idea or several ideas to a minimum valuable product

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Insights & Implications

Entrepreneurs from different fields with several years of experiences see great value in an AI-based creative assistant. They also wished they had such an assistant at an earlier stage in developing their own business.

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5   Study 2 – AI as a Creative Assistant for Creativity Workshops

The aim of the second study is to find out to what extent AI-based systems have the potential to support or even completely take over the implementation and facilitation of creativity workshops. Guidance and moderation of creativity workshops are usually left to trained facilitators, who are responsible for encouraging creativity and interaction as well as for providing appropriate surroundings, tools, materials and visualizations to ensure a smooth process (Polewsky & Will, 1996). In this study, we elaborate on which tasks an AI-based system could take over and how autonomous it should act in creative facilitation. Expert interviews were conducted with professional facilitators who have several years of experience moderating and conducting creativity workshops. We chose our experts based on their experience in conducting various workshops within established companies for a span of over at least two years. Potential participants were directly approached by the researchers, which led to the acquisition of three experts. The first expert (female) is a researcher and Design Thinking coach with two years of workshop experience for different companies. The second expert (male) is a freelancer specializing in innovation workshops and change management with a system engineering and design background. The third expert (male) is an employee of a financial services company and works as a manager of innovations with more than ten years of workshop experience.

5.1   Procedure

An interview guideline was developed based on literature from the area of moderation (Polewsky & Will, 1996) as well as on prior experience. We chose to give the interviewees enough space to elaborate on issues and the possibility to point out aspects that had not come up during the preparation of the guideline. Furthermore, the method should also ensure that all relevant aspects were captured, and regarding the coding process, answers were at least in part comparable. The interviews were conducted between 20th December 2017 and 25th January 2018 and took between 55 and 65 minutes. After conducting the interviews, they were transcribed and coded in MAXQDA version 18. Finally, the interviews were analyzed using codes as an efficient data-labeling and data-retrieval device (Miles & Huberman, 1994). The coding was done collaboratively by four researchers to distribute the effort of conducting and coding as well as to get different views on the qualitative data. Whenever the results differed, a discussion was established until a consensus was reached.

5.2   Results

The iterative coding process of the interviews has produced 219 codes and 537 coded segments and provided a number of insights into the possible use of AI-based systems to support and conduct creativity workshops.

The interviewees stated that such a system could be used in many supporting ways, for instance, method and tool support, giving tips and creative stimuli, providing multimedia-based instructions, process support,

explaining rules and remembering to follow them in case of violation, documentation and time-keeping. Especially, proactive and intelligent activities that stimulate creativity were mentioned oftentimes. Providing external feedback and input, as well as specific creative stimuli, would benefit the group or individual in the phase of divergent thinking. An AI-based system, respectively, is expected to support ad hoc changes proactively based on events. For example, if the participants' progress is stagnating, the system needs to recognize this and act on it. In such situations, the participants would normally not be able to act by themselves, so proactive actions are needed. Besides, the experts mentioned that the AI-based system should be able to recognize disruption, boredom, demotivation, frustration, disorientation, loss of focus, diverging from the topic, misuse or non-acceptance of methods, criticism, violation of rules or if too similar ideas are produced.

Prior to a workshop, the AI-based system should be able to prepare the workshop. It should support the team composition and prepare creativity methods and material. Furthermore, it should encourage a creative mindset and create an appropriate atmosphere, as well as document, record, and log the whole workshop. The AI-based system should also help by identifying overlaps between ideas, link related aspects and, to some extent, assess created ideas according to their novelty, workability, relevance, and specificity. Helping to visualize complex aspects of an idea was also mentioned by an expert as valuable support by an AI-based system. Another aspect that was mentioned throughout was the personality, appearance and overall humanness of the AI-based system. The experts mentioned that it is important for such systems to perfectly understand natural language, follow social norms of interpersonal communication, have a human appearance with facial expressions and gestures, capture emotions and be able to show emotions. In the best case, the AI-based system should not be perceived as technology or system but as a facilitator.

5.3 Implications

In summary, it can be said that workshop facilitators are remarkably sanguine about the use of AI-based systems for the support and partial conduction of creativity workshops. As an AI-based system is always accessible, it could be used asynchronously as well as in global-dispersed workshops. The number of participants in a workshop and even the number of simultaneously conducted workshops is more scalable with the support of an AI-based system. The experts mentioned, that due to the extensive usage of AI-based systems in the private sector (e.g. virtual assistants), acceptance within companies will not be a major problem as individuals are already used to them. All experts agree that AI-based systems in creativity workshops have the potential to save an enormous amount of work, enable more effective collaboration and generate new creative ideas. Especially the individual support of an AI-based system, its vast knowledge base and the possibility of a structured analysis of ideas create an enormous added value.

Aligning the experts' statements to the three aspects of person, press and process (including divergent and convergent thinking) in which AI has the potential to support creativity shows where creative potential can be induced. Table 2 summarizes the results of depicts the creative potential through AI support. The contribution of the study is discussed and summarized in the following section, along with the results from the first study.

Table 2. Creative Potential through AI as an Assistant for Creativity Workshops

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Creative potential

Person: workshop preparation, team composition, encourage mindset, explain rules and remember to follow them in case of violation, method and tool support, visualization, recognition of person-related problems (disruption, boredom, demotivation, frustration, disorientation, loss of focus, diverging from the topic, misuse or non-acceptance of methods, criticism, violation of rules)
Press: creative atmosphere, tips and creative stimuli
Process (general): process support, time-keeping, recognition of process-related problems (stagnation, wrong step,
Divergent thinking: tips and creative stimuli, provide external input
Convergent thinking: documentation, identify idea overlaps, link related aspects, idea assessment

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Insights & Implications

Creativity workshop facilitators (experts) with several years of experiences see great creative potential, added value, as well as time and cost savings by using AI-based systems for workshop support and facilitation. Such systems have the potential to autonomously support and facilitate creativity workshops and even contribute with creative stimuli and thoughts to overall increase their creative potential.

6 Outcomes and Contribution

Since creativity is an intangible construct, we refer to three core aspects of creativity (person, press and process) to analyze the creative potential and illustrate how AI-based systems have the ability to support creativity in the context of information systems (e.g. socio-technical systems). We identified several approaches in which AI can at least under the conditions of our cases support the person, process (and in detail, the divergent and convergent process), or the environment with our two studies. However, it is not always possible to distinguish clearly between the individual support approaches, as some may contain synergies with other aspects or support several aspects. In the following sections, we will discuss the identified possibilities and give eleven recommendations for organizations and entrepreneurs and, in particular, for IT departments, innovation managers and workshop moderators who can benefit from the results. In addition to the general recommendations, we then list tangible propositions on how the suggestions could be fulfilled. However, since the recommendations raise several further questions, we derive a set of open research questions, which we then present in the last section.

6.1 Person

Experts predict that AI will increase human effectiveness but will also partially undermine human autonomy and that computers will eventually match human intelligence and capabilities is probably undeniable. This assumption is already changing the way humans work and will become even more pronounced in the future. (Schwartz et al., 2019). Humans do not only create value with IT support but will jointly work with autonomous systems to create value. However, most of the creative potential lies in the person or group involved in the creative process, which is why AI-based systems should be used specifically here to foster this potential.

AI-based systems have the potential to support people at the beginning of a creative phase by supporting workshops or creativity sessions. This can relieve the burden on individuals and extract the full potential from the person or group. Research already shows how such support can look like (Bittner, Oeste-Reiß, & Leimeister, 2019; Strohmann et al., 2018). AI-based systems also have the potential to be used when composing the team and selecting individuals for the creativity process to put together a functioning group and foster the full creative potential of the individuals in the best possible way. Conceptual approaches to such assemblies have already been explored (Lamprecht, Siemon, & Robra-Bissantz, 2016; Siemon et al., 2020). During a creative phase, AI-based systems have the potential to adjust the mindset of individuals to a creative way of working and bringing method support and rules of, for example, brainstorming or other methods to the individuals. In addition, AI-based systems can, to some extent, recognize individual person-related activities and problems such as disruption, boredom, demotivation, frustration, disorientation, loss of focus, diverging from the topic, misuse or non-acceptance of methods, criticism, violation of rules and act proactively accordingly. The detection and intervention of AI-based systems has already been partially demonstrated in other research approaches (Strohmann, Siemon, & Robra-Bissantz, 2017). Especially the

active support of AI-based systems was frequently mentioned by our interviewees. For example, by contributing creative ideas, proactive behavior, triggering creative activities, method and tool support but also visualizing the own ideas created by the individuals. Also, the sharing and showing of other ideas from the team and the common combining of already created ideas, promotes the individual creative potential.

The person (or group) contains the most creative potential, which unfolds during the creative process and should thus be supported extensively. Organizations and start-ups have already recognized early on that the creative potential of their employees or company founders is essential for long-term business success (Amabile, 1988) or the success of their start-up (Siemon, Narani, Ostermeier, & Robra-Bissantz, 2016). Analog support in the form of creativity workshops or creativity methods such as brainstorming (VanGundy, 2008) is already regularly used, and IT systems that promote individual creativity (Wang & Nickerson, 2017). While these insights have already reached companies, the creative potential of individuals and groups is fostered in an analog and IT-based way. The use of AI in companies has not yet penetrated.

Our findings show the potential of AI-based systems to foster further creative potential in the individual. Recommendations for companies and start-ups are consequently:

1. Use AI-based systems in the preparation and planning of creativity sessions (including team composition)
2. Use AI-based systems to convey a creative mindset
3. Use AI-based systems to select, support and execute creativity methods
4. Use AI-based systems to identify and intervene with individual problems (e.g. demotivation, frustration or disorientation)
5. Use AI-based systems to stimulate creative thinking (thoughts)

The following tangible propositions can be taken to implement the recommendations we have established. Since there is great creative potential in the person or group, the latter should be relieved of rudimentary tasks as much as possible. When preparing creative processes, such as creativity workshops, AI could make preparations and very specifically organize participants, suggest methods, set up appointments, and send reminders (1). To strengthen a creative mindset (2), AI should be able to free individuals from certain stuck thinking patterns and put them in a creative frame of mind. This can be implemented concretely by keeping daily tasks away during creative phases and teaching a creative mindset, such as explaining how boundaries, associations and mental leaps work. Since participants or individuals in creative workshops often lack methodological expertise and facilitators have limited capacity, AI should be used to select, guide, explain, and support creativity methods (3). If problems arise, such as stagnation, incorrect approaches, or specific methodological issues, AI should identify and intervene (4). For example, if people in the brainstorming session express criticisms that are not appropriate at this point according to the method, AI has the ability to recognize them and direct the people accordingly. Also, when individuals have difficulty coming up with new ideas, AI can provide associations to stimulate participants (5). These creative stimuli can be in verbal or visual form to stimulate the creativity of the individuals.

6.2   Press (Environment)

The environment in which a creative process takes place is essential for success and the creative outcome. In the environment (press), in addition to external and physical influences, such as space, light, sounds and colors, furnishings, etc., other people or objects (also intelligent nature) are responsible for an influence. Therefore, the design of the creative environment has a significant impact on the behavior and creativity of employees and individuals in general (Dul, Ceylan, & Jaspers, 2011). In a physical environment, this is already often implemented by creating special spaces for creativity workshops and creative work environments (Amabile, 1998; Dul et al., 2011). In virtual space and especially in IT-based creativity processes, the design and appearance of systems with and through which creative work is done plays an important role (Bhagwatwar, Massey, & Dennis, 2013). Research already exists on how interfaces and systems should be designed to create the best possible creative environment in which people and groups can work creatively digitally (Shneiderman, 2000).

AI-based systems have the potential to create adaptive and individualized virtual spaces tailored to the individual ("foster a creative atmosphere tailored to the entrepreneur", as mentioned by one interviewee). They can also create free space for creativity, for example, by hiding other activities or letting the AI-based system take them over. In addition, an environment should be generated that provides tips and creative stimuli and is an external influence at the right place and time. Besides, a creative atmosphere should be

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created overall, for example, by recognizing context-sensitive data and processing it accordingly. Research in this area already shows how IT is used to capture context-sensitive data and process it intelligently (Sielis, Tzanavari, & Papadopoulos, 2009; Siemon & Robra-Bissantz, 2016).

Our findings show the potential of AI-based systems to create and sustain a creative environment. Recommendations for companies and start-ups are consequently:

6. Use AI-based systems to create an individual creative atmosphere and creative freedom.

7. Use AI-based systems to provide tips and creative stimuli at the right time and in the right place.

The developed recommendations can be pursued specifically with the following tangible propositions. The environment in which creative processes take place plays an important role in enabling creative thoughts to emerge. The environment, both physical and digital, is classified by a set of characteristics, such as the physical space, the IT/software used, the temperature and the color or volume of the environment. It can either positively affect creativity or impair creativity. AI should be used in this case to best adapt the environment to the use case, the person or group, and the moment. One example is matching the interface colors of a system to support creativity with green color elements associated with new ideas and divergent thinking (McCoy & Evans, 2002; Siemon & Robra-Bissantz, 2016). AI should automatically recognize the situation or context in which creative work is being done and how it should be adapted (6). The timing, task, and phase in the process also play an essential role in effectively providing creative stimuli here. For example, if a person is in flow, a creative stimulus should not necessarily be presented (7). The right place and time, which should be co-created by the AI, is therefore important.

6.3   Process

The process describes the sequence of different activities that lead to a person or a group systematically arriving at an idea (Basadur et al., 2000; Runco, 2004). The creative process is an interplay of divergent and convergent thinking and often does not follow a structured sequence. Both processes repeat and alternate to generate a creative idea that is both novel, original, and appropriate and relevant (Brophy, 2001; Hocevar, 1980). Most creativity techniques address the creative process and thus support the creative potential (Gabriel et al., 2016; VanGundy, 2008). There are certain methods and techniques that support divergent thinking and those that support convergent thinking (Wang & Nickerson, 2017). In digital creativity processes, too, mechanisms and functions of IT are used to support both divergent and convergent processes, although these are primarily of a passive nature and primarily take on organizational tasks (Gabriel et al., 2016; Wang & Nickerson, 2017).

AI-based systems have the potential to intelligently support the process, for example, by identifying and addressing process-related problems such as stagnation, wrong steps or timing issues. AI-based systems have the ability to also provide meaningful support for remembering to take breaks, triggering creative processes or the general management of ideas. Besides, AI-based systems have the ability to intelligently guide activities throughout the process, recognize, pick up and store ideas, and bring them back to people's attention when needed.

Especially in divergent processes, AI-based systems have the potential to support people's activities with external stimuli and creative input. For example, they can, to some extent, also promote the autonomous introduction of thought processes that may later be relevant when working on one's business model. In convergent processes, AI-based systems have means to foster creative potential, especially in documentation, in identifying idea overlaps, linking similar concepts, evaluating ideas, and selecting relevant ideas. AI also has the potential to be used in the transition to initial prototype implementations.

Our findings show the potential of AI-based systems to enhance the creative potential by supporting the process. Recommendations for companies and start-ups are consequently:

8. Use AI-based systems to monitor the creative process and identify and intervene in process-based issues

9. Use AI-based systems to provide general process support

10. Use AI-based systems to enrich and drive the divergent process with creative input

11. Use AI-based systems to evaluate, merge, identify idea overlaps, and document ideas to drive the convergent process

The creative process, consisting of an interplay of divergent and convergent thinking, can be specifically supported by AI with the following propositions. There are several systematic creativity methods and

processes that consist of different phases, are iterative but most importantly allow for breakout (Beyhl & Giese, 2016; Brenner, Uebernickel, & Abrell, 2016; VanGundy, 2008). It is important to keep track of where in the process a person or a group is, whether an iteration is necessary or whether a (potential) end has been reached. AI should therefore be used to have a holistic overview of the creative process, to be able to recognize process steps, but also to recognize process-related problems such as dead ends or non-ending iterations. Process steps are often skipped because they are not necessary in certain use cases. AI should also be able to make such suggestions (8). In addition, AI should also provide general process support, such as selecting the appropriate process according to the task. One example is design thinking, which sometimes consists of three to nine steps and should be designed differently for each use case (9) (Beyhl & Giese, 2016; Brenner et al., 2016; Redlich et al., 2019). It is precisely the divergent process that requires individual support from the AI, e.g. by stimulating creative thoughts or constantly demanding new and wild ideas. AI should also specifically try to break through possible limiting ways of thinking and to challenge wild ideas. During divergent thinking, AI also has the potential to act as a kind of counterpart to the person, in part to overcome incremental obstacles and provoke new ideas and views (10). In divergent phases, however, it is then even more important that AI acts more analytically and assists the person in bringing ideas together, breaking them down, refining them, and documenting them. AI can bring its semantic analysis capabilities to bear and assist the person in converging (11).

7   Conclusions and Perspectives for Future Research

With our two studies we showed how AI could be used in creative processes in different ways. The use of AI will fundamentally change the way humans work in the future. While the substantial effect of AI on the labor market is a popular topic in this context (Anderson et al., 2018), the collaborative work between humans and AI needs to be a major objective (Mirbabaie, Stieglitz, Brünker, et al., 2021; Seeber et al., 2020). Despite the apparent potential, this area of application is often neglected. Although AI is already being used in optimization or data analysis (Brynjolfsson & Mcafee, 2017), the intelligent support and independent work of creative tasks is an area with enormous potential. Our studies reveal valuable insights on how AI can be applied in creativity and the ability of AI to increase people´s creative potential, creative processes and the creative environment. Important insights and implications, as well as general recommendations for action, were drawn to help organizations and start-ups realize the potential of AI in creative processes and invest accordingly to remain innovative and competitive in the long term. Thus, our findings contribute not only to creativity research but also, more specifically, to research on socio-technical systems in the context of creativity support. In doing so, we could contribute to how the interplay between people, creative challenges (tasks) and technology, namely AI, can lead to greater creative potential.

Our results also contribute to teaching, such as innovation management or creativity. Our findings show that AI has the potential to act not only as an autonomous technology that works in an automated way using modern algorithms and generates ideas independently. But above all, it has the potential to foster creative potential in interaction with humans, thus becoming part of a hybrid intelligence that has the ability to solve creative tasks. Traditional models such as the 4 P's model (Rhodes, 1961), show where creative potential exists and how creative products can arise, must therefore also be adapted. The role of AI, which can support the person, the press, as well as the process, must be included in the future. Consequently, creative potential lies not only in one's own employees or other external stakeholders (Chesbrough, 2013), such as customers, but also in AI and should thus be included as an active contributor in creative tasks. This results in innovative products and services that can lead companies to long-term business success, which are no longer developed by humans alone, but with AI. Consequently, this also has a major impact on companies' innovation management and far-reaching implications that must continue to be discussed, such as protecting ideas or patent law.

We have deliberately not demonstrated specific manifestations of AI or discussed what forms AI-based systems can take, as the nature of AI and, in particular, the question of what form AI can take varies greatly. One form of AI-based systems primarily in applied human-AI interaction are chatbots, virtual assistants or other conversational user interfaces (Maedche et al., 2016; McTear et al., 2016). With their ability to interact with humans, such AI-based systems have the potential to be used particularly well in socio-technical systems to foster creative potential. Especially due to their partially human design, they are perceived by humans as equal partners and used in collaborative scenarios (Nass & Moon, 2000; Siemon et al., 2018). Nevertheless, AI can also take the form of non-embodied systems that primarily perform intelligent tasks, such as providing creative stimuli, planning workshops, or intelligently documenting creative processes. The exact design of AI and, consequently, AI-based systems for creativity processes is, therefore, an aspect

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that requires further research. Here, especially the perception of the AI-based system is an important aspect that is highly relevant, e.g. acceptance.

Our recommendations and our approaches to implement them also raise a number of new research questions and call for further research. The first thing to note is that many of our recommendations portray AI as equal partners by taking on important tasks that entail a strong and steadfast view. Also, when it comes to bringing ideas together, evaluating ideas, and making decisions, AI acts in a determining and decisive way that requires acceptance and equality. This raises the question of when AI is perceived as co-equal and whether this depends solely on capabilities or also on behaviors. The first open research question is, therefore:

ORQ1: What criteria afford AI to be perceived as a co-equal partner in creative working scenarios?

If AI now supports the creative person or the group, the question of acceptance and trust arises. If the AI makes critical decisions, suggestions for improvement or even negative evaluations of one's own idea, the question arises of how people react to the AI's input, whether they ignore it or are even intimidated. Even if the AI determines relevant processes and decides in favor of certain methods, the AI must be trusted to make the right decisions. The following open research questions, therefore, need to be addressed.

ORQ2: How do we ensure and increase trust in decisions and suggestions made by AI in creative working scenarios?

Creative processes involving multiple people are subject to many synergistic effects and group dynamics that can lead to both positive effects and negative effects (Siemon, Becker, Eckardt, & Robra-Bissantz, 2019). Social and cognitive factors influence creative work and trigger reactions and behaviors in people (Diehl & Stroebe, 1991; Karau & Williams, 1997; Siemon et al., 2019), such as social loafing, free riding or social comparison. If AI now takes an active role in this process, intervenes, suggests and makes other contributions, the question arises to what extent people would react and possibly reduce or increase their creative effort when AI is involved.

ORQ3: How does the implementation of AI in creative working scenarios influence a person's behavior?

Research in the field of the creative environment has already produced a number of findings on how, among other things, the physical and the virtual environment should look to promote creativity in the best possible way (Siemon & Robra-Bissantz, 2016). If AI is now being used to shape the creative environment, it is important to examine what impact AI has on the creative process in general. As part of the environment, the question arises as to how the mere presence of AI in the environment affects creativity.

ORQ4: How does the mere presence of AI within the creative environment affect creativity?

AI's support of the creative process invokes a number of new research questions, such as when it makes sense to intervene in the creative process or how creative interventions should be used to enhance the process in a meaningful way rather than disrupting it. Especially as many different creative processes and thinking patterns exist, it is important when and how AI should or can adequately intervene.

ORQ5: When and how should AI intervene in creative processes to promote them in a meaningful way?

Moreover, many of these open research questions and approaches also entail a number of design-oriented issues, such as implementing embodied AI-based systems. It is not only the behavior, capabilities, and tasks of AI that need to be considered but also what AI will look like in a specific case. Further, open research questions should therefore address the design of AI that is specifically used in creative processes. Future research can, therefore, build on our results and recommendations and develop specific designs of AI-based systems for the different support possibilities and tackle the raised open research questions. With our findings, we were, therefore, able to create an overview of the potential of AI in creativity and show empirical-based recommendation and tangible approaches to the extent to which the creative potential of organizations can be exploited.

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