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

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Abstract:

This paper shows how start-ups or established organizations can improve their creative performance via using AI-based systems to actively promote creative processes. With insights from two studies conducted with entrepreneurs, innovation managers, and workshop facilitators, we provide recommendations for companies and entrepreneurs on how they can use 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 use AI-based systems to enhance the creative potential of the person, the process or the press (environment). Our findings also provide theoretical insights into perceiving AI as an equal partner and call for further research on designing 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 and to secure market shares continue to grow. Digitization poses enormous challenges for companies but holds the potential for organizational transformation (Wessel et al., 2021). Innovations, which can create competitive advantages and ensure sustainable success, represent a key factor in this challenging environment (Flynn et al., 2003; Weerawardena & Mavondo, 2011). Therefore, companies and organizations need innovative products and services and novel and adequate methods for their development to respond to dynamic changes in markets and customer needs (Amabile & Pratt, 2016; Somech & Drach-Zahavy, 2013). In addition to established companies, young companies and start-ups trying to enter the market with new products or services also need to innovate constantly. Particularly against the backdrop of global crises such as the coronavirus disease of 2019 (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, organizations need to be innovative and to produce new and innovative ideas as quickly as possible in order to stand out from the competition.

Creativity represents a decisive factor for generating ideas and developing novel products and services (Amabile & Pratt, 2016; Gassmann & Zeschky, 2008). Researchers have recognized creativity as a critical factor that directly influences organizational success (Amabile, 1988; Gabriel et al., 2016) and found that improving creative performance represents a key factor to overcome external tensions, promote novelty, and produce innovation (Amabile & Pratt, 2016) for countless professions and businesses since creative performance sets innovation in motion (Paulus et al., 2012). Thus, to produce valuable innovations, both startups and established companies need to pay more attention to supporting creativity (Shalley et al., 2009).

Nowadays, organizations use information technology (IT) to shape the way in which they support creativity (Gabriel et al., 2016; Massetti, 1996; Wang & Nickerson, 2017). They design and implement computers and software systems to systematically support various creativity tasks and processes via specific mechanisms and functionalities that can enhance the creative outcome (Gabriel et al., 2016; Wang & Nickerson, 2017). However, organizations have not yet thoroughly explored the possibilities that IT offers, and they have not yet examined and developed the way computer systems can enhance creativity as IT constantly evolves and new forms of support emerge (Cropley et al., 2021; Gabriel et al., 2016; Wang & Nickerson, 2017).

Due to an enormous increase in computing power and novel algorithms and methods (Ransbotham et al., 2018), recent advances have brought artificial intelligence (AI) back into public awareness and research interest. AI offers companies new possibilities to innovate on 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 and not just IT companies such as Google, Apple, and Facebook now invest in developing AI capabilities and focus their corporate strategy and investment planning on using AI (Ransbotham et al., 2017, 2018).

However, organizations use AI methods such as machine learning mostly to process natural language or classify large amounts of data and, thereby, generate added value (von Krogh, 2018). The huge amount of data that business activities generate and its permanent availability led to significant investments in AI technologies, such as powerful and almost unlimited scalable computing capacities, which many consider the essential basis of AI procedures (von Krogh, 2018). Furthermore, the many AI-based services that exist today make it seemingly easy for companies (specially small and medium-sized 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 in using AI for their business models and have started to use it, they have yet to apply it to many other areas.

In addition to the missing the necessary knowledge, established companies with a traditional business model and small and medium-sized companies often do not know how to create added value by using AI (Ransbotham et al., 2017), which the often hyped but limited way in which many organizations and people view AI plays an essential role in. CIOs and managers equate AI with analyzing large amounts of data, with intelligent robots, or with 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 et al., 2016). Similarly, many organizations and

individuals view do not sufficiently understand the possible ways in which they can apply AI in knowledge-intensive internal business processes (Liebowitz, 2001). In particular, they often overlook applying AI to innovation management and, more precisely, to support creative processes (Colton & Wiggins, 2012). Companies can and should use the significant potential that AI offers in the creative process area to strengthen their innovative power, to bring novel products and services to the market, and, thus, to remain constantly competitive (Cropley et al., 2021).

In recent years, researchers have increasingly called for more research on collaboration between humans and AI (Mirbabaie et al., 2021a, 2021b; Seeber et al., 2019, 2020; Siemon et al., 2020, 2018). For example, many researchers have advocated for the "machines as teammates research agenda" and for more research in the artifact design and collaboration design areas (Seeber et al., 2019). A research panel held at the European Conferences on Information Systems in 2019 also discussed potential ways to use AI beneficially in future human-AI collaboration scenarios (Seeber et al., 2020). The panel addressed, among other things, AI's analytical capabilities, which have relevance in the knowledge and learning area, and its ability to support decision making. However, Seeber et al. (2019, 2020) mention creativity only in passing. Seeber et al. (2019) noted that some organizations already use AI to generate creative solutions autonomously. However, they question the extent to which this autonomous creativity could limit humans' creativity. Although researchers have already conducted much work on AI's ability to autonomously generate ideas (e.g., in the computer science and, specifically, computational creativity domains), IS researchers have conducted little work on how humans interact with AI to go through creative processes (Boden, 2009; Colton & Wiggins, 2012; Lubart, 2005; Seeber et al., 2019; Siemon et al., 2018).

Thus, in this study, we examine the following research question (RQ):

RQ: How can organizations use AI to increase their creative potential?

To answer this question, we first depict possible aspects in the creative process that AI could potentially support and identify existing studies and approaches that specifically support creativity via AI-based systems. Furthermore, we report the results from studies that we conducted on how selected AI aspects can support creative processes. Specifically, we identified 11 approaches (i.e., specific suggestions) for implementing AI for creativity support. With our results, we show how AI-based systems can enhance a person's, group's, process's or environment's creativity. In doing so, we 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 among AI's many manifestations and forms (e.g., conversational agents) they can apply in creative processes.

2 Artificial Intelligence and Creativity

Creativity represents a valuable human characteristic that gives people the ability to create something new or original and yet useful (Boden, 2009). Research regards creativity as something that drives innovation and ensures corporate success and, thus, as a basic requirement for a flourishing economy (LeBel, 2008; Wong et al., 2005). Companies recognized creativity's value to generate innovative products or services early on (Amabile & Pratt, 2016). Especially when it comes to solving complex problems or improving processes, creativity constitutes a fundamental resource (Amabile, 1988; Amabile & Pratt, 2016). Therefore, many organizations try to support their employees and external stakeholders in providing creative outcomes. Dedicated departments that ensure systematic innovation management promote creative potential both in their organizations and outside them (Chesbrough, 2013; Flynn et al., 2003). In an analog context, organizations typically promoted creative potential with assistance from creativity workshops and facilitators, while, in a digital context, they typically use IT to design systems that support creative processes. These systems 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 represents an intangible term associated with outcomes from a process (product), person, or group; a process itself; or an ability or way of thinking, the way in which organizations support creativity varies greatly (Hennessey & Amabile, 2010; Rhodes, 1961). Rhodes (1961) defined creativity based on four distinct aspects (i.e., **person**, **product**, **press**, and **process**) that influence whether creativity occurs, and they represent essential cornerstones for any creativity research. Today, this creativity model still shows where creative potential lies and explains how one can support creativity (Gruszka & Tang, 2017).

As a heuristic activity, creativity implies that one requires a process to develop an idea (i.e., the creative outcome, also called a product) (Hennessey & Amabile, 2010; Runco, 2004). This process includes

various ways of thinking or, more specifically, various ways to create fragments, form associations, create several aspects of an idea (divergent phase), merge fragments, and combine ideas (convergent phase) (Basadur et al., 2000; Runco, 2004). Since the creativity process comprises both divergent thinking and convergent thinking, it requires different support approaches. For example, in the divergent phase, methods or systems help form actors form associations or allow mental leaps (Basadur et al., 2000; Brophy, 2001; Hocevar, 1980; Holyoak, 1996). In the convergent process, actors need support to recognize patterns and summarize aspects (Brophy, 2001; Cropley, 2006). Furthermore, beneficial input and creative abilities support the person or group involved in generating ideas. 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, every creative process focuses on producing a product (namely, the creative outcome). For the best outcome possible to occur (product), the relevant individuals (person), processes, and environment (press) require appropriate support (Dean et al., 2006; Rhodes, 1961). Figure 1 overviews creativity's four aspects.

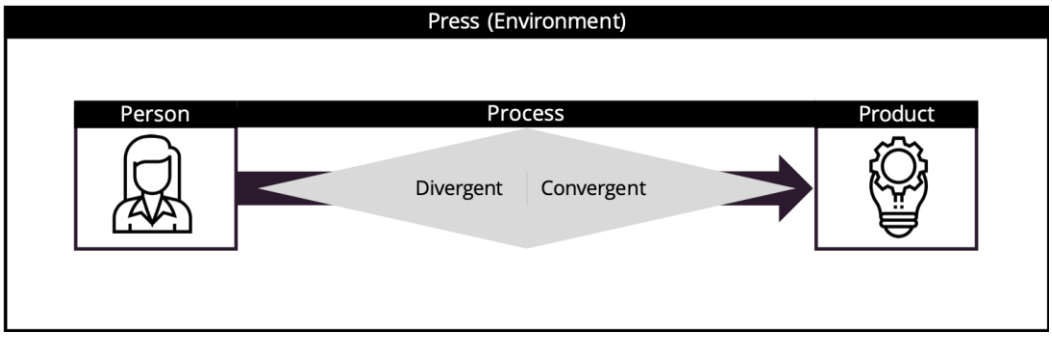

Figure 1. Creativity's Aspects

As AI has risen in popularity and use, systems have 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 AI's birth, the term creativity appeared as, among other things, a key goal for AI (Boden, 2009; McCarthy et al., 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 et al., 2009, p. 12).

Research in the computer science discipline has often focused on developing algorithms, such as artificial neural networks, which generate novel ideas without human influence (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 et al., 2018). In addition, AI-based systems have made creative decisions in filmmaking (Elson & Riedl, 2007; ScriptBook, 2018) and other organizational disciplines (Aleksander, 2017; Anderson et al., 2018; Schwartz et al., 2019). A leading researcher in computational creativity, Margaret Boden, has argued that research on computational creativity has helped better explain creativity and that computers can perform combinatorial and transformational explorations (Boden, 2009). Creating a system that can compose a new piece of music, for example, helps one understand the procedures that a human brain needs to perform to conduct such a creative task (Widmer et al., 2009). Consequently, computer scientists and, more specifically, researchers in computational creativity, care about how AI has the ability to generate creative outcomes (product) independent of human influence.

IS research considers socio-technical systems and the interplay between people, tasks and technology. For humans to solve problems with assistance from AI (technology), AI needs to take 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 a given problem (Maher & Fisher, 2012). Combining AI's power with human creativity, "the complementary strengths of human intelligence and AI" (Dellermann et al., 2019, p. 637) in a so-called hybrid intelligence result in better performance than the two do separately. Accordingly, AI-based systems and people can work together to solve creative tasks (Randrup et al., 2016; Seeber et al., 2019; Siemon et al., 2020). Dellermann et al. (2019) discuss how hybrid intelligence means not only that AI augments human intelligence but also that human

intelligence augments AI. They refer to these two approaches as artificial intelligence in the human intelligence loop and human intelligence in the AI loop. Their approach clearly shows the difference between computational creativity research, which does not pursue hybrid intelligence, and IS research, which always involves considering and interacting with humans.

3 Creative Potential through Artificial Intelligence

Due to creativity's complex nature, creative potential has many aspects, and one can support it in myriad 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 that an IT system can provide into four categories: 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 supports 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 in the idea-generation process). Finally, the 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 et al., 2015; Boden, 1998; Colton & Wiggins, 2012). AI can now somewhat perform abilities that one could initially attribute only to humans (Besold et al., 2015).

The computational creativity discipline focuses on how IT independently creates creative products without human influence and interaction, while the IS discipline consider the interplay between people, tasks. and technologies. Therefore, we do not focus on AI-based systems that autonomously achieve creative results without human interaction in this study since they belong to the computer science discipline. However, IS researchers argue that "humans and computers have complementary capabilities that can be combined to augment each other" (Dellermann et al., 2019, p. 4). Researchers that have examined concepts such as hybrid intelligence, human-machine symbiosis or human-in-the-loop have argued that superior results emerge when one combines 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 et al., 2020). In the creativity context, this logic means that, when working together on a creative task, humans and IT (in this case, AI-based systems) increase the overall creative potential.

Due to creativity's various aspects and the resulting support possibilities, we need to overview the potential ways in which AI-based systems may fundamentally support creativity. According to Figure 1, we identified four aspects where AI may contribute to support creativity:

1) **Person:** people constitute essential parts of creativity since they possess the most creative potential. Experience, skills, and thinking behavior, which people can train and develop, shape creativity (Cropley, 1999; Rhodes, 1961).
2) **Press (environment):** the environment involves all aspects in individuals' surrounding context. Entities in the environment can provide input that stimulates individuals to enhance or even impair their creative performance (Amabile, 1988; Rhodes, 1961).
3) **Process**: the creative process involves all fundamental heuristic actions that actors conduct to create a novel idea. It involves various activities, and one can divide it into two distinctive ways of thinking (Basadur et al., 2000; Rhodes, 1961):
    - ***Process—divergent thinking*:** this thought process generates creative ideas by exploring many possible solutions (Cropley, 1999; Cropley, 2019; Hocevar, 1980).
    - ***Process—convergent thinking*:** this thought process follows a particular set of logical steps to arrive at one solution (Akbari Chermahini & Hommel, 2012; Brophy, 2001).
4) **Product:** all aspects lead to one or more creative outcomes, the idea or ideas that become embodied into a tangible form (called the product) (Runco, 2004).

AI can either autonomously create the product, which the computational creativity or computer science disciplines research, or the product can result from a process between humans and technology (AI), which the IS discipline researches. As we mention above, IS research considers socio-technical systems that

address specific tasks through an interplay between humans and IT. As such, computer science or computational creativity research rather than IS research focuses on creative outcomes that AI generates autonomously without humans influence (Colton & Wiggins, 2012). In our research, we consider how information systems (i.e., AI in the interplay between humans) perform creative tasks. Therefore, the creative outcome (i.e., the product) always results from a collaborative effort between humans and AI (i.e., a hybrid effort). In this paper, we look at socio-technical aspects in which one could use AI beneficially and, thus, leave the product out of the equation.

Accordingly, we conducted two studies to gain more detailed insights into the potential ways in which AI-based systems could support creative processes, people, and environments. 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 that AI-based systems may have on human creativity. We use the results 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 using AI-based systems in creative processes. We report the results from two different studies in which an AI-based system took on two different roles: 1) a creative assistant for entrepreneurs and 2) a creative assistant for creativity workshops. All studies involved participants working in established companies or as entrepreneurs in start-ups who reported their perceptions of and expectations for creative support and joint work with AI-based systems. We report and discuss our findings from these studies and conclude with insights, implications, and recommendations for companies and start-ups. Specifically, we identify requirements for successfully implementing AI in creative processes and derive recommendations for organizations, entrepreneurs, and AI designers. By using different organization levels to study how the participants perceived a supportive AI element in their creative processes, we generated comprehensive, diverse, and, therefore, transferable knowledge. We clearly found that all organizational levels foresee AI's impact 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. Specifically, we found that AI has the opposite effect as people on all organizational levels see how AI may profit them, though they also recognize its limitations.

4 Study 1: AI as a Creative Assistant for Entrepreneurs

We conducted the first study to examine the potential for an AI-based creative assistant to support entrepreneurs in early business stages and in their daily business life. Research has proven creativity to be fundamental for start-ups in their early stages and throughout the entire entrepreneurial process (Siemon et al., 2017). However, especially in their daily business, entrepreneurs often struggle to harness their creativity due to the many tasks they have to cover (Oosterbeek et al., 2010). For this reason, we investigate to what extent a creative assistant can 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 reliable method to obtain knowledge that one would otherwise find hard to discover (Bogner, Littig, & Menz, 2009). Overall, we interviewed six entrepreneurs with diverse business activities from different branches:

1) A female entrepreneur who founded a concept store and online shop for interior, fashion, and plants
2) A male entrepreneur who co-founded an IT start-up to support the initiation phase between retailers and customers with an AI-based mobile application
3) A male entrepreneur who co-founded 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
4) A female entrepreneur and entrepreneurship professor who founded a consultancy to help small and medium-sized companies write grant applications, and
5) Two female entrepreneurs who worked as graphic designers for advertising media.

4.1 Procedure

We developed a semi-structured interview guideline based on our prior experience and literature concerning entrepreneurship (Reis, 2011; Ward, 2004) and virtual assistants (McTear, Callejas, & Griol,

2016). The interview guideline included both closed- and open-ended questions we used to better understand entrepreneurs' thoughts and views. The interview guide included aspects such as 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.

We conducted the interviews between 18 April and 18 November, 2018, and they took between 37 and 74 minutes. After conducting the interviews, we transcribed and coded them with MAXQDA version 18. We analyzed the interviews using codes as an efficient data-labeling and data-retrieval device (Miles & Huberman, 1994). We independently inductively conducted the coding whereby we identified and grouped different patterns in the text. After a first round, we discussed the codes we created to find consensus. We repeated this process 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 ways in which an AI-based creative assistant could support entrepreneurs. All interviewees mentioned that they often did not lack creativity but that they did lack the freedom to implement the solutions due to many other tasks they had to do. They also mentioned other problems related to conducting creativity methods, managing ideas, or sharing them in teams. To help prepare the entrepreneurs mentally for the idea that an AI-based creative assistant could help them in a creative capacity, we discussed how preexisting AI-based systems such as Apple's Siri or Amazon's Alexa already provide active support to people worldwide. Since all participants had already gained experience with these systems, they could imagine the human way to interact with them. We continued this thought with the assumption that technology will continue to progress and, thus, so would AI-based systems' potential and functionality. After this introduction, we prepared the entrepreneurs to discuss the possibilities of such solutions. One potential aspect that emerged from the discussions concerned AI-based support for idea management. Since entrepreneurs generally possess high creativity (Ko & Butler, 2007), they come up with many ideas that require intelligent processing and management (process, convergent thinking). At times and places where they would find it difficult to further develop such ideas ("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, which means entrepreneurs often forget/discard and, thus, do not further follow them. At this point, an AI-based system could collect those ideas, proactively structure and process them, and remind the entrepreneurs to deal with them later. Moreover, the interviewees indicated that the AI-based system should foster creativity with a proactive behavior by reminding for pauses or creative sessions (process) and help entrepreneurs to conduct creativity methods (person, process). An AI-based system (person, process) might also help entrepreneurs recognize when they should trigger a creative process or use creative activities. In addition to direct creative support, the system could also provide information for a start-up project and support entrepreneurs in their respective business phase (process, convergent thinking).

4.3 Implications

In summary, we found that entrepreneurs would consider receiving support from an AI-based creative assistant and would have highly benefited from its use. A creative assistant could create space for creative time and actively help collect and structure ideas and support to transform them into a minimum viable product. All entrepreneurs agreed that such an assistant would need to do so in a safe and reliable way. In particular, we found that a creative assistant would prove especially interesting for entrepreneurs who sought to start or have started a business on their own to have a partner but also for teams to coordinate. These results apply equally to internal start-ups and spin-offs from existing companies in which entrepreneurs face similar conditions. We summarize the results and depict AI's potential to creative support entrepreneurs in Table 1.

Table 1. AI as a Creative Assistant for Entrepreneurs

Creative potential **Person**: fostering creativity through proactive behavior, helping team members exchange ideas, capturing brainwaves (creative moments), triggering creative activities. **Press**: create free space for creativity, foster a creative atmosphere tailored to the entrepreneur **Process** (general): reminding entrepreneurs about specific activities that involve creativity, helping entrepreneurs to conduct creativity methods, automatically storing ideas, identifying idle times, managing ideas (e.g., collecting ideas, reminding about ideas, helping to conduct brainstorming). **Divergent thinking**: autonomously collect information concerning the business idea, stimulating creative thoughts **Convergent thinking**: helping entrepreneurs select ideas to continue with the creative process (e.g., to continue prototyping or working on a sales strategy), helping them initially evaluate ideas, supporting the process to bring an idea or several ideas to a minimum valuable product.
Insights and Implications Entrepreneurs from different disciplines with several years of experiences saw 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.

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

We conducted the second study to determine to what extent AI-based systems have the potential to support or even completely take over from humans in implementing and facilitating creativity workshops. Trained facilitators with the responsibility to encourage creativity and interaction and provide appropriate surroundings, tools, materials, and visualizations to ensure a smooth process usually conduct creativity workshops (Polewsky & Will, 1996). In this study, we elaborate on which tasks an AI-based system could take over and how autonomously it should act in creative facilitation. We conducted expert interviews with professional facilitators who had several years' experience in moderating and conducting creativity workshops. We chose our experts based on their experience in conducting various workshops in established companies for at least two years. We directly approached several potential participants, and three agreed to participate:

1) A female researcher and design thinking coach with two years of workshop experience for different companies
2) 2) A female freelancer who specialized in innovation workshops and change management with a system engineering and design background, and
3) 3) A male employee who worked at a financial services company as an innovation manager and had more than ten years of workshop experience.

5.1 Procedure

We developed an interview guideline based on literature from the moderation area (Polewsky & Will, 1996) and on our own prior experience. We gave the interviewees enough space to elaborate on issues and the possibility to point out aspects that had not come up when we prepared the guideline. We also ensured that we captured all relevant aspects and, as for the coding process, that we could at least partly compare the answers. We conducted the interviews between 20 December, 2017, and 25 January, 2018, and they took between 55 and 65 minutes. After conducting the interviews, we transcribed and coded them with MAXQDA version 18. Finally, we analyzed the interviews using codes as an efficient data-labeling and data-retrieval device (Miles & Huberman, 1994). We independently conducted the coding before discussing our results. Whenever the results differed, we discussed them until we reached consensus.

5.2 Results

From the coding process, we identified 219 codes and 537 coded segments that provided many insights into possible ways to use AI-based systems to support and conduct creativity workshops.

The interviewees stated that they could use such a system in many supporting ways, such as to support methods and tools, to give tips and creative stimuli, to provide multimedia-based instructions, to support processes, to explain rules and offer reminders to follow them in case violations occur, to document events, and to keep the time. In particular, the interviewees often mentioned proactive and intelligent activities that stimulate creativity. They thought that external feedback, input, and specific creative stimuli would benefit individuals or groups in the divergent thinking stage. They expected that an AI-based

system should be able to support ad hoc changes proactively based on events. For example, if participants' process stagnated, the system would need to recognize and act on it. Participants would normally not be able to act by themselves in such situations, which meant they required proactive actions. Besides, the experts mentioned that the AI-based system should be able to recognize disruption, boredom, demotivation, frustration, disorientation, loss of focus, divergence from the topic, method misuse or non-acceptance, criticism, rule violations, and overly similar produced ideas.

An AI-based system should be able to prepare a workshop before it begins. It should support the team composition and prepare creativity methods and material. Furthermore, it should encourage a creative mindset, create an appropriate atmosphere, and document, record, and log the whole workshop. The AI-based system should also be able to identify overlaps between ideas, link related aspects, and, to some extent, assess created ideas according to their novelty, workability, relevance, and specificity. An expert also mentioned the ability for an AI system to help in visualizing complex ideas as valuable support. The experts also mentioned the system's personality, appearance, and overall humanness. They said that such systems should be able to perfectly understand natural language, follow social norms of interpersonal communication, have a human appearance with facial expressions and gestures, and capture and show emotions. In the best case, people should not perceive AI-based systems as technology or a system but as a facilitator.

5.3 Implications

In summary, the workshop facilitators seemed remarkably positive about using AI-based systems to support and partially conduct creativity workshops. Since one can always access an AI-based system, one could use it asynchronously in globally dispersed workshops. One can better scale the number of participants in a workshop and even the number of simultaneously conducted workshops with support from an AI-based system. The experts mentioned that, due to how extensively organizations in the private sector use AI-based systems (e.g., virtual assistants), acceptance in companies would not pose a major problem as individuals have already become used to them. All experts agreed 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. In particular, the individual support, vast knowledge base, and potential to structurally analyze ideas that an AI-based system offers would add enormous value.

In Table 2, we align the experts' statements to person, environment, and process (including divergent and convergent thinking) to illustrate where AI has the potential to support creativity and induce creative potential.

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

Creative potential **Person**: preparing workshops, supporting team composition, encouraging mindsets, explaining rules and offering reminders to follow them in case violations occur, supporting methods and tools, visualizing complex ideas, recognizing person-related problems (disruption, boredom, demotivation, frustration, disorientation, loss of focus, topic divergence, method misuse or non-acceptance, criticism, rule violations) **Press**: creating a creative atmosphere, providing tips and creative stimuli **Process** (**general**): providing process support, keeping the time, recognizing process-related problems (stagnation, wrong steps) **Divergent thinking**: providing tips, creative stimuli, and external input **Convergent thinking**: documenting activities, identifying idea overlaps, linking related aspects, assessing ideas
Insights and implications Creativity workshop facilitators (experts) with several years of experiences saw great creative potential, added value, and 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 represents an intangible construct, we refer to its three core aspects (person, environment, and process) to analyze AI-based systems' creative potential and illustrate how these systems have the ability to support creativity in the IS context (e.g., socio-technical systems). We identified several approaches in which AI can (at least under our case conditions) support people,

processes (divergent and convergent process), and/or the environment with our two studies. However, one cannot always clearly distinguish clearly between the individual support approaches as some may contain synergies with other aspects or support several aspects. In this section, we discuss the identified possibilities and make 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 one could fulfill the suggestions. However, since the recommendations raise several further questions, we derive several open research questions that we present in the last section.

6.1 Person

Experts predict that AI will not only increase human effectiveness but also partially undermine human autonomy and that computers will likely eventually match human intelligence and capabilities. This assumption has already begun to change the way humans work and will become even more pronounced in the future (Schwartz et al., 2019). Humans will not only create value with IT support but also jointly work with autonomous systems to create value. However, the creative potential largely lies in the person or group involved in the creative process, which explains why AI-based systems should support them to foster this potential.

AI-based systems have the potential to support people when starting a creative phase by supporting workshops or creativity sessions. In doing so, they can relieve the burden that individuals face and extract their full potential. Research already shows what such support could look like (Bittner et al., 2019; Strohmann et al., 2018). AI-based systems also have the potential to help one select individuals and compose teams for the creativity process to put together a functioning group and foster their full creative potential in the best possible way. Researchers have already explored conceptual approaches to such assemblies have (Lamprecht et al., 2016; Siemon et al., 2020). During a creative phase, AI-based systems have the potential to adjust individuals' mindset to a creative way of working and bringing method support and rules about, 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, topic divergence, method misuse or non-acceptance, criticism, rule violations and act proactively accordingly. Research has already partially demonstrated that AI-based systems can detect topic divergences, loss of focus or misuse, and non-acceptance of methods and intervene accordingly (Strohmann et al., 2017). However, the interviewees frequently mentioned that AI-based systems could provide active input and support, such as contributing creative ideas, triggering creative activities, and visualizing ideas that people created in addition to passive support, such as detecting flaws in creative processes or visualizing ideas that people created.

Organizations and start-ups have long recognized that their employees' or founders' creative potential represents an essential factor to whether they succeed (Amabile, 1988; Siemon et al., 2016). Organizations regularly use analog support such as creativity workshops or creativity methods such as brainstorming to improve their creative potential (VanGundy, 2008; Wang & Nickerson, 2017). While these insights have already reached companies, they have continued to foster individuals' and groups' creative potential in an analog and IT-based way. AI use has not yet penetrated them.

Based on our findings, we make several recommendations to companies and start-ups about how they can use AI-based systems to foster their employees' or their creators' creative potential:

1) Use AI-based systems when preparing and planning creativity sessions (which includes in deciding on a team's composition): for example, AI could make preparations and specifically organize participants, suggest methods, set up appointments, and send reminders.
2) Use AI-based systems to convey a creative mindset: AI can free individuals from certain stuck thinking patterns and put them in a creative frame of mind. Organizations can implement this recommendation concretely by keeping daily tasks away during creative phases and teaching a creative mindset, such as explaining how boundaries, associations, and mental leaps work.
3) Use AI-based systems to select, support, and execute creativity methods since participants or individuals in creative workshops often lack methodological expertise and facilitators lack the necessary capacity to constantly intervene and moderate.
4) Use AI-based systems to identify and intervene in individual problems (e.g., demotivation, frustration, or disorientation, stagnation, incorrect approaches, or specific methodological

issues): for example, if people in the brainstorming session express inappropriate criticisms at particular time according to the method, AI has the ability to recognize the inappropriate criticisms and direct people accordingly.

5) Use AI-based systems to stimulate creative thinking: for example, when individuals have difficulty coming up with new ideas. These creative stimuli can be in verbal or visual form.

6.2 Press (Environment)

The environment in which a creative process occurs has an influential role in whether it succeeds and the creative outcome. In the environment (press), in addition to external and physical influences such as space, light, sounds and colors, and furnishings, other people or objects (also intelligent nature) also contribute to this influence. Therefore, a creative environment's design has a significant impact on the behavior and creativity of employees and individuals in general (Dul et al., 2011). In a physical environment, actors often implement a creative environment by creating special spaces for creativity workshops and creative work environments (Amabile, 1998; Dul et al., 2011). In virtual spaces and especially in IT-based creativity processes, systems' design and appearance play an important role in creativity processes (Bhagwatwar et al., 2013). Research already exists on how one should design interfaces and systems 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 one interviewee mentioned). They can also create free space for creativity, such as by hiding other activities or letting the AI-based system take them over. In addition, AI-based systems should generate an environment that provides tips and creative stimuli. Besides, AI-based systems should create a creative atmosphere by, for example, recognizing context-sensitive data and processing it accordingly. Research in this area already shows how IT can capture context-sensitive data and process it intelligently to stimulate creativity (Sielis et al., 2009; Siemon & Robra-Bissantz, 2016).

Based on our findings, we make several recommendations to companies and start-ups about how they can use AI-based systems to help create and sustain a creative environment:

6) Use AI-based systems to create an individual creative atmosphere and creative freedom: the environment in which creative processes occur plays an important role in enabling creative thoughts to emerge. Various factors characterize the environment (both physical and digital) such as the physical space, the IT/software used, temperature, and color. These factors can either positively or negatively affect creativity. Organizations can use AI to adapt the environment to the use case, the person or group, and/or the moment. For example, a creativity support system's interface could change its colors (e.g., to green, which research has associated with new ideas and divergent thinking, when individuals need to generate new ideas) (McCoy & Evans, 2002; Siemon & Robra-Bissantz, 2016).

7) Use AI-based systems to provide tips and creative stimuli at the right time and in the right place: for example, if a person is in flow, a system should not necessarily present the person with creative stimulus.

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 involves interplay between divergent and convergent thinking and often does not follow a structured sequence. Both processes repeat and alternate to generate a novel, original, and appropriate and relevant creative idea (Brophy, 2001; Hocevar, 1980). Most creativity techniques address the creative process and, thus, support creative potential (Gabriel et al., 2016; VanGundy, 2008). Certain methods and techniques support divergent thinking and others support convergent thinking (Wang & Nickerson, 2017). In digital creativity processes, too, IT mechanisms and functions can support both divergent and convergent processes, although they primarily have a passive nature and take on organizational tasks (Gabriel et al., 2016; Wang & Nickerson, 2017).

AI-based systems have the potential to intelligently support the creative process by, for example, 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 via helping people remember to take

breaks, triggering creative processes, or managing ideas in general. Besides, AI-based systems have the ability to intelligently guide activities throughout the creative process; recognize, pick up, and store ideas; and bring them back to people's attention when needed.

In divergent processes in particular, AI-based systems have the potential to support people's activities with external stimuli and creative input. For example, to some extent, they can also autonomously introduce thought processes that may later become relevant when one works on a business model. In convergent processes, AI-based systems have means to foster creative potential, especially in documenting, identifying idea overlaps, linking similar concepts, evaluating ideas, and selecting relevant ideas. AI also has the potential to support individuals in transitioning to initial prototype implementations.

Based on our findings, we make several recommendations to companies and start-ups about how they can use AI-based systems to support the creative process:

8) Use AI-based systems to monitor the creative process and identify and intervene in process-based issues: since the creative process comprises interplay between divergent and convergent thinking, AI can support it with several systematic (and iterative) creativity methods and processes that comprise different phases but, most impotantly, allow for breakout (Beyhl & Giese, 2016; Brenner et al., 2016; VanGundy, 2008). Individuals/groups need to keep track of where in the process they are, whether they need to iterate, or whether they have reached a (potential). Thus, AI should be able to holistically overview the creative process, to recognize process steps, and to recognize process-related problems such as dead ends or non-ending iterations. Individuals/groups often skip process steps because certain use cases do not require them. AI should also be able to make such suggestions.

10) Use AI-based systems to provide general process support (e.g., selecting the appropriate process according to the task): as an example, in design thinking, which sometimes comprises three to nine steps, an AI-based system should design the process differently for each case (Beyhl & Giese, 2016; Brenner et al., 2016; Redlich et al., 2019). Use AI-based systems to enrich and drive the divergent process with creative input: for example, AI can stimulate creative thoughts or ask for 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

11) Use AI-based systems to evaluate, merge, and identify idea overlaps and to document ideas to drive the convergent process: in divergent phases, AI needs to act more analytically and assist 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

7 Conclusions and Perspectives for Future Research

With our two studies, we show how one can leverage AI in creative processes in different ways. Using AI will fundamentally change the way humans work in the future. While the substantial effect that AI will have on the labor market represents a popular topic in this context (Anderson et al., 2018), the collaborative work between humans and AI needs to be a major objective for research to address and practice to implement (Mirbabaie et al., 2021a; Seeber et al., 2020). Despite the apparent potential, research often neglects this application area. Although many organizations already use AI in optimization or data analysis (Brynjolfsson & Mcafee, 2017), the intelligent support of and autonomous contributions to creative tasks represents an area with enormous potential. We identified valuable insights into how one can apply AI in creativity and its ability to increase people's, processes', and environments' creative potential. We offer important insights, implications, and general recommendations 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 creativity support context. In doing so, we 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 topics, such as innovation management or creativity. Our findings show that AI has the potential to not only act as an autonomous technology using contemporary algorithms and generates ideas independently but also to foster humans' creative potential and, thus, help

contribute to a hybrid intelligence that has the ability to solve creative tasks. Thus, researchers must adapt, refine, and rethink traditional models such as the 4P model (Rhodes, 1961), which show where creative potential exists and how creative products can arise. Researchers must include the role of AI, which can support the person, the press, and the process, in the 4P model 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, thus, should be included as an active contributor in creative tasks.

We have deliberately not demonstrated specific AI manifestations or discussed what forms AI-based systems can take since AI can vary greatly in nature. However, chatbots, virtual assistants, and other conversational user interfaces constitute one major form that AI-based systems can take in human-AI interactions (Maedche et al., 2016; McTear et al., 2016). With their ability to interact with humans, such AI-based systems have the potential to see use in socio-technical systems that foster creative potential. In particular, humans often perceive such systems as equal partners and use them in collaborative scenarios (Nass & Moon, 2000; Siemon et al., 2018). Nevertheless, AI can also take forms such as non-embodied systems that primarily perform intelligent tasks, such as providing creative stimuli, planning workshops, or intelligently documenting creative processes. In any case, further research needs to examine how to design AI and, consequently, AI-based systems for creativity processes. For example, the perception of the AI-based system is an important aspect (especially on for acceptance).

Our recommendations and our approaches to implement them also raise several new research questions and call for further research. First, we note that many recommendations we make in this paper 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, which raises questions about when people perceive AI as equal and whether their perceiving AI as equal depends solely on its capabilities and/or behavior. Thus, we propose the first research question (RQ) for future research to address:

RQ1: What criteria influence whether people perceive as an 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.

RQ2: How do we ensure and increase trust in decisions and suggestions that AI makes in creative working scenarios?

Creative processes that involve multiple people experience many synergistic effects and group dynamics that can lead to both positive effects and negative effects (Siemon et al., 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, offers suggestions, and makes other contributions, the question arises to what extent people would react and possibly reduce or increase their creative effort when it involves AI. Accordingly, we propose:

RQ3: How does implementing AI in creative working scenarios influence a person’s behavior?

Research in the creative environment domain has already produced several findings on how, among other things, the physical and the virtual environment should promote creativity in the best possible way (Siemon & Robra-Bissantz, 2016). If organizations now use AI to shape the creative environment, we need examine what impact AI has on the creative process in general. Thus, we propose:

RQ4: How does AI’s mere presence in the creative environment affect creativity?

AI that can support the creative process invokes several new research questions, such as when it makes sense to intervene in the creative process or how one should use creative interventions to enhance the creative process in a meaningful way rather than disrupting it. Thus, we propose:

RQ5: When and how should AI intervene in creative processes to promote them in a meaningful way?

These open research questions and approaches also entail various design-oriented aspects. We need to consider not only AI's behavior, capabilities, and tasks but also what AI will look like in a specific case. Therefore, open research questions should address how one should design AI that specifically contributes to creative processes. Future research can, therefore, build on our results and recommendations and develop specific ways to design AI-based systems for the different support possibilities and tackle the raised open research questions.

References

Akbari Chermahini, S., & Hommel, B. (2012). Creative mood swings: Divergent and convergent thinking affect mood in opposite ways. *Psychological Research*, *76*(5), 634-640.

Aleksander, I. (2017). Partners of humans: A realistic assessment of the role of robots in the foreseeable future. *Journal of Information Technology*, *32*(1), 1-9.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. *Research in Organizational Behavior*, *10*, 123-167.

Amabile, T. M. (1998). *How to kill creativity*. Harvard Business School Publishing.

Amabile, T. M., & Gryskiewicz, N. D. (1989). The creative environment scales: Work environment inventory. *Creativity Research Journal*, *2*, 231-253.

Amabile, T. M., & Pratt, M. G. (2016). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior*, *36*, 157-183.

Anderson, J., Rainie, L., & Luchsinger, A. (2018). Artificial intelligence and the future of humans. *Pew Research Center*. Retrieved from https://www.pewresearch.org/internet/2018/12/10/artificial-intelligence-and-the-future-of-humans/

Azoulay, P., & Jones, B. (2020). Beat COVID-19 through innovation. *Science*, *368*(6491), 553-553.

Basadur, M., Runco, M. A., & Vegaxy, L. A. (2000). Understanding how creative thinking skills, attitudes and behaviors work together: A causal process Model. *The Journal of Creative Behavior*, *34*, 77-100.

Besold, T. R., Schorlemmer, M., & Smaill, A. (2015). *Computational creativity research: Towards creative machines* (1st ed.). Atlantis Press.

Beyhl, T., & Giese, H. (2016). The design thinking methodology at work: Capturing and understanding the interplay of methods and techniques. In H. Plattner, C. Meinel, & L. Leifer (Eds.), *Design thinking research* (p. 49-65). Springer.

Bhagwatwar, A., Massey, A., & Dennis, A. R. (2013). Creative virtual environments: Effect of supraliminal priming on team brainstorming. In *Proceedings of the 46th Hawaii International Conference on System Sciences.*

Bittner, E. A. C., Oeste-Reiß, S., & Leimeister, J. M. (2019). *Where is the bot in our team? Toward a taxonomy of design option combinations for conversational agents in collaborative work*. In *Proceedings of the 52th Hawaii International Conference on System Sciences.*

Boden, M. A. (1998). Creativity and artificial intelligence. *Artificial Intelligence*, *103*, 347-356.

Boden, M. A. (2004). *The creative mind: Myths and mechanisms*. Psychology Press.

Boden, M. A. (2009). Computer models of creativity. *AI Magazine*, *30*(3), 23-34.

Bogner, A., Littig, B., & Menz, W. (2009). *Experteninterviews: Theorien, methoden, anwendungsfelder* (3rd ed.). Springer.

Brenner, W., Uebernickel, F., & Abrell, T. (2016). Design thinking as mindset, process, and toolbox. In In W. Brenner & F. Uebernickel (Eds.), *Design thinking for innovation* (pp. 3-21). Springer.

Brophy, D. R. (2001). Comparing the attributes, activities, and performance of divergent, convergent, and combination thinkers. *Creativity Research Journal*, *13*(3-4), 439-455.

Brynjolfsson, E., & Mcafee, A. (2017). The business of artificial intelligence. *Harvard Business Review*. Retrieved from https://hbr.org/2017/07/the-business-of-artificial-intelligence

Chesbrough, H. (2013). *Open business models: How to thrive in the new innovation landscape*. Harvard Business Press.

Cohn, G. (2018). Up for bid, AI art signed “algorithm”. *The New York Times*. Received from https://www.nytimes.com/2018/10/22/arts/design/christies-art-artificial-intelligence-obvious.html

Colton, S., López de Mantaras, R., & Stock, O. (2009). Computational creativity: Coming of age. *AI Magazine*, *30*(3), 11-14.

Colton, S., & Wiggins, G. A. (2012). Computational creativity: The final frontier? In *Proceedings of the 20th European Conference on Artificial Intelligence*.

Cope, D. (2015). Computational creativity and music. In T. R. Besold, M. Schorlemmer, & A. Smaill (Eds.), *Computational creativity research: Towards creative machines* (pp. 309-326). Atlantis Press.

Cropley, A. (2006). In praise of convergent thinking. *Creativity Research Journal*, *18*(3), 391-404.

Cropley, A. J. (1999). Creativity and cognition: Producing effective novelty. *Roeper Review*, *21*(4), 253-260.

Cropley, D. H. (2019). Creativity, innovation and the future of engineering. In *Proceedings of the World Engineers Convention.*

Cropley, D., Medeiros, K., & Damadzic, A. (2021). The intersection of human and artificial creativity. In D. Henrisken & P. Mishra (Eds.), *Creative provocations: Speculations on the future of creativity, technology, & learning*. Springer.

De Mantaras, R. L., & Arcos, J. L. (2002). AI and music: From composition to expressive performance. *AI Magazine*, *23*(3), 43-43.

Dean, D. L., Hender, J. M., Rodgers, T. L., & Santanen, E. L. (2006). Identifying quality, novel, and creative ideas: Constructs and scales for idea evaluation. *Journal of the Association for Information Systems*, *7*(10), 646-699.

Dellermann, D., Ebel, P., Söllner, M., & Leimeister, J. M. (2019). Hybrid intelligence. *Business & Information Systems Engineering*, *61*(5), 637-643.

Diehl, M., & Stroebe, W. (1991). Productivity loss in idea-generating groups: Tracking down the blocking effect. *Journal of Personality and Social Psychology*, *61*(3), 392-403.

Dul, J., Ceylan, C., & Jaspers, F. (2011). Knowledge workers' creativity and the role of the physical work environment. *Human Resource Management*, *50*(6), 715-734.

Elson, D. K., & Riedl, M. (2007). *A lightweight intelligent virtual cinematography system for machinima production*. *Proceedings of the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment*, *3*(1), 8-13.

Fink, A., Koschutnig, K., Benedek, M., Reishofer, G., Ischebeck, A., Weiss, E. M., & Ebner, F. (2012). Stimulating creativity via the exposure to other people's ideas. *Human Brain Mapping*, *33*(11), 2603-2610.

Flynn, M., Dooley, L., O'sullivan, D., & Cormican, K. (2003). Idea management for organisational innovation. *International Journal of Innovation Management*, *7*(4), 417-442.

Gabriel, A., Monticolo, D., Camargo, M., & Bourgault, M. (2016). Creativity support systems: A systematic mapping study. *Thinking Skills and Creativity*, *21*, 109-122.

Gassmann, O., & Zeschky, M. (2008). Opening up the solution space: The role of analogical thinking for breakthrough product innovation. *Creativity and Innovation Management*, *17*(2), 97-106.

Gerber, A., Derckx, P., Döppner, D. A., & Schoder, D. (2020). Conceptualization of the human-machine symbiosis—a literature review. In *Proceedings of the 53th Hawaii International Conference on System Sciences.*

Gruszka, A., & Tang, M. (2017). The 4P's creativity model and its application in different fields. In M. Tang & C. H. Werner (Eds.), *Handbook of the management of creativity and innovation: Theory and practice* (p. 51-71). World Scientific.

Hennessey, B. A., & Amabile, T. M. (2010). Creativity. *Annual Review of Psychology*, *61*, 569-598.

Hocevar, D. (1980). Intelligence, divergent thinking, and creativity. *Intelligence*, *4*(1), 25-40.

Holyoak, K. J. (1996). *Mental leaps: Analogy in creative thought*. MIT Press.

Karau, S. J., & Williams, K. D. (1997). The effects of group cohesiveness on social loafing and social compensation. *Group Dynamics: Theory, Research, and Practice*, *1*(2), 156-168.

Ko, S., & Butler, J. E. (2007). Creativity: A key link to entrepreneurial behavior. *Business Horizons*, *50*, 365-372.

Lamprecht, J., Siemon, D., & Robra-Bissantz, S. (2016). Cooperation isn't just about doing the same thing—using personality for a cooperation-recommender-system in online social networks. In *Proceedings of the International Conference on Collaboration and Technology.*

Larson, D. A. (2010). *Artificial intelligence: Robots, avatars and the demise of the human mediator*. *Ohio State Journal on Dispute Resolution*, *25*(1).

LeBel, P. (2008). The role of creative innovation in economic growth: Some international comparisons. *Journal of Asian Economics*, *19*(4), 334-347.

Liebowitz, J. (2001). Knowledge management and its link to artificial intelligence. *Expert Systems with Applications*, *20*(1), 1-6.

Liu, B., Fu, J., Kato, M. P., & Yoshikawa, M. (2018). Beyond narrative description: generating poetry from images by multi-adversarial training. *In Proceedings of the ACM Multimedia Conference on Multimedia Conference.*

Lubart, T. (2005). How can computers be partners in the creative process: Classification and commentary on the special issue. *International Journal of Human-Computer Studies*, *63*, 365-369.

Maedche, A., Morana, S., Schacht, S., Werth, D., & Krumeich, J. (2016). Advanced user assistance systems. *Business & Information Systems Engineering*, *58*(5), 367-370.

Maher, M. L., & Fisher, D. H. (2012). Using AI to evaluate creative designs. In *Proceedings of the 2nd International Conference on Design Creativity.*

Massetti, B. (1996). An empirical examination of the value of creativity support systems on idea generation. *MIS Quarterly*, *20*(1), 83-97.

McCarthy, J., Minsky, M. L., Rochester, N., & Shannon, C. E. (2006). A proposal for the Dartmouth summer research project on artificial intelligence. *AI Magazine*, *27*(4), 12-14.

McCoy, J. M., & Evans, G. W. (2002). The potential role of the physical environment in fostering creativity. *Creativity Research Journal*, *14*(3-4), 409-426.

McMullen, J. S., & Shepherd, D. A. (2006). Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. *Academy of Management Review*, *31*(1), 132-152.

McTear, M., Callejas, Z., & Griol, D. (2016). *The conversational interface: Talking to smart devices. Springer.*

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.

Mirbabaie, M., Stieglitz, S., Brünker, F., Hofeditz, L., Ross, B., & Frick, N. R. J. (2021a). Understanding collaboration with virtual assistants—the role of social identity and the extended self. *Business & Information Systems Engineering*, *63*(1), 21-37.

Mirbabaie, M., Stieglitz, S., & Frick, N. R. J. (2021b). Hybrid intelligence in hospitals: Towards a research agenda for collaboration. *Electronic Markets*, *31*, 365-387.

Nass, C., & Moon, Y. (2000). Machines and mindlessness: Social responses to computers. *Journal of Social Issues*, *56*(1), 81-103.

Oosterbeek, H., van Praag, M., & Ijsselstein, A. (2010). The impact of entrepreneurship education on entrepreneurship skills and motivation. *European Economic Review*, *54*(3), 442-454.

Paulus, P. B., Dzindolet, M., & Kohn, N. W. (2012). Collaborative creativity—group creativity and team innovation. In M. Mumford (Ed.), *Handbook of organizational creativity* (p. 327-357). Academic Press.

Polewsky, S., & Will, H. (1996). Creativity workshops: Tools for innovation in organizations? *European Journal of Work and Organizational Psychology*, *5*(1), 43-51.

Randrup, N., Druckenmiller, D., & Briggs, R. O. (2016). Philosophy of collaboration. In *Proceedings of the 49th Hawaii International Conference on System Sciences.*

Ransbotham, S., Gerbert, P., Reeves, M., Kiron, D., & Spira, M. (2018). Artificial intelligence in business gets real. *MIT Sloan Management Review*. Retrieved from http://www.g20ys.org/upload/auto/0dad0db3709738947e175182ed3de4bb6e29bb64.pdf

Ransbotham, S., Kiron, D., Gerbert, P., & Reeves, M. (2017). Reshaping business with artificial intelligence: Closing the gap between ambition and action. *MIT Sloan Management Review*. Retrieved from https://sloanreview.mit.edu/projects/reshaping-business-with-artificial-intelligence/

Redlich, B., Becker, F., Fischer, S., Fromm, J., Gernreich, C., Lattemann, C., Pöppelbuß, J., Siemon, D Wilms, K. (2019). Das DETHIS-verfahren. In V. Stich, J. H. Schumann, D. Beverungen, G. Gudergan, & P. Jussen (Eds.), *Digitale Dienstleistungsinnovationen: Smart services agil und kundenorientiert entwickeln* (p. 73-88). Springer.

Reis, E. (2011). *The lean startup*. Random House.

Rhodes, M. (1961). An analysis of creativity. *The Phi Delta Kappan*, *42*(7), 305-310.

Runco, M. A. (2004). Creativity. *Annual Review of Psychology*, *55*, 657-687.

Schwartz, J., Hagel, J., III., Wooll, M., & Monahan, K. (2019). Reframing the future of work. *MIT Sloan Management Review*, *60*(3), 1-6.

ScriptBook. (2018). *Man and machine: AI as (co)-creator in storytelling.* Retrieved from https://blog.scriptbook.io/man-and-machine-ai-as-co-creator-in-storytelling-537e5995ea88

Seeber, I., Bittner, E., Briggs, R. O., de Vreede, T., de Vreede, G.-J., Elkins, A., Maier, R., Merz, A. B., Oeste-Reiß, S., Randrup, N., Schwabe, G., & Söllner, M. (2019). Machines as teammates: A research agenda on AI in team collaboration. *Information & Management*, *57*(2).

Seeber, I., Waizenegger, L., Seidel, S., Morana, S., Benbasat, I., & Lowry, P. B. (2020). Collaborating with technology-based autonomous agents. *Internet Research*, *30*(1), 1-18.

Shalley, C. E., Gilson, L. L., & Blum, T. C. (2009). Interactive effects of growth need strength, work context, and job complexity on self-reported creative performance. *The Academy of Management Journal*, *52*(3), 489-505.

Shneiderman, B. (2000). Creating creativity: User interfaces for supporting innovation. *ACM Transactions on Computer-Human Interaction, 7*(1), 114-138.

Sielis, G. A., Tzanavari, A., & Papadopoulos, G. A. (2009). Enhancing the creativity process by adding context awareness in creativity support tools. In *Proceedings of the International Conference on Universal Access in Human-Computer Interaction*.

Siemon, D., Becker, F., Eckardt, L., & Robra-Bissantz, S. (2019). One for all and all for one—towards a framework for collaboration support systems. *Education and Information Technologies*, *24*(2), 1837-1861.

Siemon, D., Li, R., & Robra-Bissantz, S. (2020). Towards a model of team roles in human-machine collaboration. In *Proceedings of the International Conference on Information Systems.*

Siemon, D., Narani, S. K., Ostermeier, K., & Robra-Bissantz, S. (2016). Creativity and entrepreneurship—the role of creativity support systems for start-ups. In *Proceedings of the Mediterranean Conference on Information Systems.*

Siemon, D., Narani, S. K., & Robra-Bissantz, S. (2017). The benefits of creativity support systems for entrepreneurs: An exploratory study. *In Proceedings of the America's Conference on Information Systems.*

Siemon, D., & Robra-Bissantz, S. (2016). Design guidelines for context-aware creativity support systems. *Journal of Creativity and Business Innovation*, *2*, 5-19.

Siemon, D., Strohmann, T., & Robra-Bissantz, S. (2018). The virtual collaborator—a definition and research agenda. *International Journal of E-Collaboration, 14*, 24-43.

Somech, A., & Drach-Zahavy, A. (2013). Translating team creativity to innovation implementation: The role of team composition and climate for innovation. *Journal of Management*, *39*(3), 684-708.

Strohmann, T., Fischer, S., Siemon, D., Brachten, F., Lattemann, C., Robra-Bissantz, S., & Stieglitz, S. (2018). Virtual moderation assistance: Creating design guidelines for virtual assistants supporting creative workshops. In *Proceedings of the 22nd Pacific Asia Conference on Information Systems*.

Strohmann, T., Siemon, D., & Robra-Bissantz, S. (2017). brAInstorm: Intelligent assistance in group idea generation. In *Proceedings of the International Conference on Design Science Research in Information System and Technology.*

VanGundy, A. B. (2008). *101 activities for teaching creativity and problem solving* (1st ed.). John Wiley & Sons.

von Krogh, G. (2018). Artificial intelligence in organizations: New opportunities for phenomenon-based theorizing. *Academy of Management Discoveries*, *4*(4), 404-409.

Wang, K., & Nickerson, J. V. (2017). A literature review on individual creativity support systems. *Computers in Human Behavior*, *74*, 139-151.

Ward, T. B. (2004). Cognition, creativity, and entrepreneurship. *Journal of Business Venturing*, *19*(2), 173-188.

Weerawardena, J., & Mavondo, F. T. (2011). Capabilities, innovation and competitive advantage. *Industrial Marketing Management*, *40*(8), 1220-1223.

Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., & Blegind-Jensen, T. (2021). Unpacking the difference between digital transformation and IT-enabled organizational transformation. *Journal of the Association for Information Systems*, *22*(1), 102-129.

Widmer, G., Flossmann, S., & Grachten, M. (2009). YQX plays Chopin. *AI Magazine*, *30*, 35-48.

Wong, P. K., Ho, Y. P., & Autio, E. (2005). Entrepreneurship, innovation and economic growth: Evidence from GEM data. *Small Business Economics*, *24*, 335-350.

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