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SPECIAL ISSUE ARTICLE OPEN ACCESS

# AI-Augmented Approaches to Creative Problem-Solving: A Metacognitive Perspective

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## ABSTRACT

Generative artificial intelligence (GenAI) is transforming the way people approach creative problem-solving (CPS). Whereas previous technologies were only used as creativity tools, GenAI can also be conceived as an actor taking on different roles that adds a collaborative element to individual CPS processes. So far, research on augmenting CPS with GenAI has focused on creative cognition. In this article, we use a metacognitive perspective as a unique lens to conceptualize AI-augmented approaches to CPS and explore the implications of AI-augmented creative cognition. Based on this, we propose that the collaboration with GenAI in CPS shifts a part of human attention away from executing to monitoring and controlling creative cognition. These imposed metacognitive demands have important implications for our theoretical understanding of AI-augmented CPS and how people can better actualize the creative potential of GenAI. Future research directions and empirical approaches for understanding and addressing these metacognitive demands are discussed along with practical implications for applying CPS.

## 1 | Introduction

Solving problems creatively has long been regarded as a uniquely human ability, an assumption that is now being challenged by the development of technological potential of generative artificial intelligence (GenAI; Moura 2023). Transformer-based language models such as ChatGPT have risen to a level that matches human performance in generating outcomes that are commonly considered 'creative' (Guzik et al. 2023; Haase and Hanel 2023). In some studies, ideas generated by ChatGPT were, on average, even rated more 'creative' than ideas created by humans (Bohren et al. 2024). Some scholars have argued that the outputs of GenAI only represent an artificial type of creativity that lacks other defining elements of human creativity such as intentionality (Runco 2023) or experiencing satisfaction with the outcome (Abraham 2024). Others asserted that GenAI only builds on existing knowledge, limiting the likelihood of coming up with radical breakthroughs (Cromptley and Cromptley 2023).

However, as human input is still needed to provide direction, the most likely scenario of GenAI application is not automation but rather augmentation of creative thinking (Marrone et al. 2024). Thus, besides comparing the outcomes and results of GenAI versus human creative efforts, another line of research explores GenAI as a tool for augmenting human creativity (O'Toole and Horvát 2024). In this regard, large field experiments in the context of knowledge workers have already demonstrated that people performed significantly better on creative problem-solving (CPS) tasks when they had access to GenAI (Dell'Acqua et al. 2023; Dell'Acqua et al. 2025; Noy and Zhang 2023).

Although the outputs of both GenAI and human creativity may appear similar, there are likely to be important differences in how these outputs are obtained (Holyoak 2024). Thus, augmenting creative thinking with GenAI may also affect internal creative processes (Aru 2025). Raisch and Fomina (2024) conceptualized the collaboration of people

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with GenAI as a new form of ‘hybrid problem-solving’. In this regard, scholars have begun to explore the many applications of GenAI for creativity and innovation management (Gama and Magistretti 2025). This has involved explaining AI-augmented CPS across different creative process stages (Bouschery et al. 2023; He et al. 2023), at different organizational levels (Grilli and Pedota 2024), and for producing a variety of types of desired creative outcomes (Ivcevic and Grandinetti 2024).

Contributing to this line of research, we use a metacognitive perspective in this article to theoretically explore the implications of augmenting creative cognition with GenAI. At its core, metacognition refers to thinking about thinking (Flavell 1979) and describes how people become aware of and can actively adapt their cognitive processes such as generating ideas. Thus, creative metacognition refers to people’s ability to monitor and control their creative cognition such as recognizing that their ideas are not original enough and choosing a different approach to generating ideas (Lebuda and Benedek 2023). In other words, creative metacognition involves ‘... a combination of self-knowledge (being aware of one’s creative strengths and limitations) and contextual knowledge (knowing when, where, how, and why) to be creative’ (Kaufman and Beghetto 2013, 160). Although the relevance of metacognition in CPS is widely acknowledged (e.g., Kennett and Ackerman 2023; Lebuda and Benedek 2025; Urban and Urban 2025), it has not yet been systematically discussed in exploring AI-augmented creative processes. Yet, this is important as the capabilities of GenAI such as the collaboration in natural language are distinct from previous technologies and impose metacognitive demands on users (Tankelevitch et al. 2024). Thus, we argue that fully actualizing the creative potential of GenAI requires a better understanding of the metacognitive implications of AI-augmented creative cognition.

More specifically, we propose in this article that by increasing the speed and volume of information processing, GenAI shifts a part of human attention away from executing to monitoring and controlling creative cognition. Further, GenAI adds a collaborative element to individual creative processes that requires additional metacognitive knowledge, monitoring and control. This has important implications for our theoretical understanding of AI-augmented CPS, as well as developing the relevant skills to address these metacognitive demands in practice.

We provide a foundation for these arguments by briefly reviewing the role of cognition and metacognition as well as their linkages in contemporary theories of CPS. Based on this, we develop propositions concerning the metacognitive demands of AI-augmented creative cognition as well as the potential of GenAI to augment creative metacognition. We conclude with a vista for future research pointing towards promising research questions and empirical approaches to advance our understanding of AI-augmented CPS.

## 2 | Cognition and Metacognition in CPS

In a broad sense, creativity can be conceived as a ‘... special class of problem-solving activity characterized by novelty, unconventionality, persistence and difficulty in problem formulation’

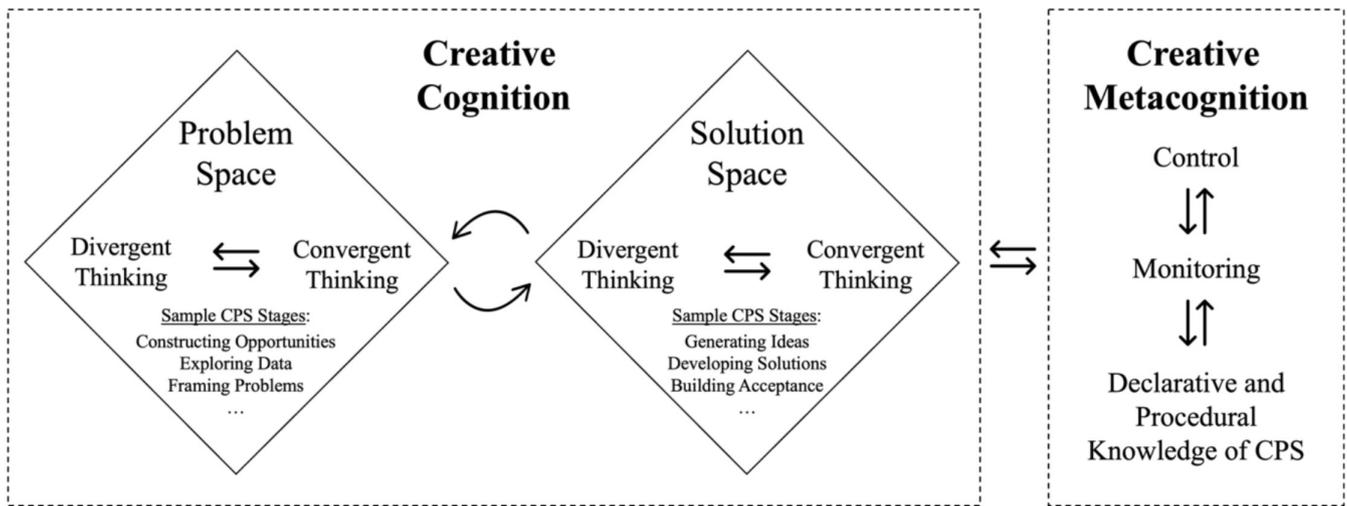
(Newell et al. 1962, 63). In this regard, CPS is a process ‘for approaching a problem in an imaginative way resulting in effective action’ (Noller 1977, 5). Within this process, both creative cognition and metacognition are dynamically intertwined. To build a foundation for our discussion on the metacognitive demands of AI-augmented approaches to CPS, we first outline common elements of creative cognition and metacognition and discuss their linkages within CPS.

### 2.1 | Cognition in CPS

Cognition has been defined as acquiring knowledge and understanding through mental processes such as awareness, comprehension, reasoning, judgement and information processing (De Houwer et al. 2017). We refer to creative cognition as the cognitive processes involved in CPS to produce creative outcomes such as associative thinking or analogical reasoning (Ward and Kolomyts 2019). Despite the nuanced variety within the various CPS models published in the literature, there is general agreement regarding the kinds of stages and functions of cognition involved in CPS (see Mumford and Fichtel 2025, or Sawyer 2012 for reviews). It is generally accepted that the CPS process includes identifying and selecting broad opportunities and constructing well-defined problems (Abdulla et al. 2020; Reiter-Palmon et al. 2024). Acquiring knowledge, data and information also plays a key role (Harms et al. 2020). Generating ideas, which has been most often associated with creativity, is a well-established stage of CPS (Peterson and Pattie 2024). Further, there is a difference between ‘raw’ ideas and more elaborated concepts (Hua et al. 2022), which is why most CPS models also emphasize the selection and development of potential solutions and gaining acceptance for their implementation (Watts 2023).

At its core, cognition in CPS involves a dynamic interplay between divergent (i.e., generating multiple options) and convergent (i.e., narrowing and focusing the options) thinking (Cortes et al. 2019; Pinkow 2023). This is inherent in common creative process theories and can occur throughout the creative process such as generating and focusing on different ways of framing a problem or generating and selecting ideas as solutions to problems. It is often emphasized that the switching between these processes (i.e., allowing first for divergence to broaden the pool of available options before evaluating them) increases the number of creative solutions (Reiter-Palmon et al. 2024; Wigert et al. 2024). From an aggregated perspective, people may generally converge on promising options in later stages of the creative process. Yet, from a nuanced perspective, more iterative cycles of divergence and convergence may appear (Dooley and Van de Ven 2016). For example, divergence may become more confined within targeted directions when moving from raw ideas to elaborated concepts or prototypes (Litchfield 2008). In the natural progression of creative cognition in CPS, the switching between these two kinds of thinking can happen so fast that they seem to occur concurrently (Goldschmidt 2016).

As the nuanced differences of divergent and convergent thinking in different stages of CPS are not relevant for our arguments in this article, we focused on the widely used double-diamond model as a simplified and more abstract representation of the CPS process (Freisinger and McCarthy 2024; Kochanowska and



**FIGURE 1** | Creative cognition and metacognition in CPS.

Gagliardi 2022). This simplified model focuses on the so-called problem and solution spaces that describe the available pool of options to understand and solve a specific problem (represented by the diamond shapes in Figure 1). As illustrated in Figure 1, other more nuanced CPS stages that are described in the literature can be subsumed as subprocesses involved in exploring the problem or solution space. For example, Isaksen's (2023) CPS model, which has been identified as one of the more comprehensive and widely used frameworks (Benedek and Lebuda 2024), includes six stages. His notion of constructing opportunities, exploring data and framing problems can be seen as a more nuanced perspective on exploring the problem space. His notion of generating ideas, developing solutions and building acceptance can be seen as a more nuanced perspective on exploring the solution space. The dynamic interplay between divergent and convergent thinking can occur across all these stages (Isaksen 2023). Thus, from this simplified perspective, creative cognition can be understood as all divergent and convergent cognitive processes that are involved in broadening and deepening the search for alternatives within the problem and solution space.

There are different approaches *how* people can engage in divergent and convergent creative cognition. This includes, for example, imaginary, associative, analogical or combinatorial thinking (Ward and Kolomyts 2019) as well as using external or internal stimuli and explicit (i.e., systematic) or implicit (i.e., intuitive) cognitive processing (Wang 2019). Different approaches to engaging in creative cognition may correspond with different creative outcomes that vary, for example, in their degree of novelty (Pinkow 2023).

Further, divergent and convergent creative cognition can be deliberately facilitated with creativity techniques that provide structured procedures aimed at evoking certain creative cognitive processes and are also referred to as CPS tools (Van Gundy 1981; Vernon et al. 2016). Although the terms are often used interchangeably, we refer to tools as concrete artefacts and techniques as the way people are using these artefacts to engage in divergent or convergent creative cognition. For example, a long-established CPS tool that facilitates divergent thinking is

morphological synthesis (Allen 1962) that provides a structured template for generating alternative options by combining different possible manifestations of key components of an underlying problem or a potential solution. If an individual needed to identify different options for creating a pizza, they could identify parameters like potential doughs for the crust, its possible shapes, toppings or sauces. If the individual generated 10 options for each of those four parameters, the result would be 10,000 alternatives. The tool does not actually engage in divergent creative cognition; it provides a concrete organizing structure within which creative cognition takes place. An example of an established tool that facilitates convergent thinking is the evaluation matrix (Parnes 1966) that provides a structure for systematically evaluating a small number of promising possibilities against several different explicit criteria.

Different tools and techniques support distinct approaches to divergent and convergent creative cognition such as facilitating the generation of paradigm-preserving or paradigm-breaking ideas (McFadzean 1998). Although some tools may be best applied for a specific stage or purpose, most tools are aimed at either divergent or convergent thinking and can be applied within any stage of the CPS process (Isaksen 2023). Whereas creative cognition in CPS refers to the actual production of creative outcomes, metacognition determines *how* people engage in creative cognition such as deliberately choosing or adapting CPS tools and techniques that correspond to the perceived task requirements in a particular situation.

## 2.2 | Metacognition in CPS

Based on the seminal work of Flavell (1979), metacognition refers to the active monitoring and control of cognitive processes. As such, metacognition plays a causal role in higher order cognitive processes such as self-regulation (Rhodes 2019; Winne 2018) or executive function (Follmer and Sperling 2016; Roebbers 2017). These higher order processes provide for the planning, monitoring, controlling and adapting of lower, or first-order, cognitive processes such as those involved in creative cognition. Pesut (1990, 107) was among the first scholars

who deliberately linked metacognition to stages of the creative process and indicated:

... creative thought is conceptualized as a function of attention/awareness deployment. It is hypothesized that in a given context it is possible for an individual to 'be aware of being aware' or consciously invoke the use of creativity technologies in order to guide thinking and behavior in an effort to generate creative associations that are useful to the development of a desired outcome.

Creative metacognition involves three interrelated components (i.e., metacognitive knowledge, monitoring and control) that govern how people engage in creative cognition (Lebuda and Benedek 2023). First, metacognitive knowledge consists of declarative knowledge including what individuals know about creativity tools, CPS processes and creative outcomes, as well as their strengths and weaknesses regarding their creative cognition such as their creative abilities or styles (Kaufman and Beghetto 2013). This knowledge guides the selection, evaluation and correction of cognitive strategies. Further, it includes procedural knowledge that relates to knowledge about how to engage in creative cognition and apply creativity techniques (Pinkow 2023). This also includes knowledge about the conditions when and why to use cognitive strategies and skills effectively (Kallio et al. 2018). Second, metacognitive monitoring in CPS refers to the ability to plan, monitor and evaluate the effectiveness of creative cognition (Lebuda and Benedek 2023). This involves an awareness of the current approach to creative cognition including an understanding of the task requirements and ongoing appraisal of the outcomes, such as evaluating the creativity of the ideas that were generated so far. It also includes metacognitive experiences and feelings as an affective component such as the overall perception of the relative ease or difficulty of creative cognition (Puente-Diaz and Cavazos-Arroyo 2022). Third, metacognitive control in CPS relates to the regulation of creative cognition and includes adjusting task goals, distributing time and attention and selecting creativity tools and techniques (Lebuda and Benedek 2023).

As illustrated in Figure 1, the three components of creative metacognition are dynamically interrelated. Metacognitive knowledge serves as the foundation for monitoring and controlling creative cognition. For example, people may perceive that the fluency of idea generation is relatively low (i.e., monitoring) that signals them a need to adapt their approach to creative cognition (i.e., control), which, in turn, shifts the attention of monitoring. Reflection on these metacognitive experiences in CPS (e.g., what worked well or not) can build metacognitive knowledge. In this sense, the breadth and depth of people's declarative (i.e., theoretical) and procedural (i.e., practical) metacognitive knowledge determine the range of metacognitive strategies they can apply during CPS process engagement.

The relevance of creative metacognition has been widely acknowledged and empirically supported (e.g., Benedek and Lebuda 2024; Lebuda and Benedek 2025; Urban and Urban 2023a, 2025). In essence, this means that when people

engage in creative metacognition, they take a reflective and adaptive approach to CPS and are more likely to produce creative outcomes. Further, metacognition is a skill that can be deliberately developed via training (De Boer et al. 2018; Stanton et al. 2021) or induced by external interventions such as using self-regulatory prompts to evoke metacognitive thinking when involved in CPS (Zielinska et al. 2025). Although most research in this area has focused on generating ideas as creative outcomes (Jia et al. 2019), scholars have more recently stressed the importance of taking a process perspective and focusing on different CPS stages such as framing problems (Linnell and Reiter-Palmon 2023).

Historically, many models of CPS have depicted the process as a predetermined, linear sequence of stages. In contrast, contemporary research has stressed the iterative nature of creative processes (Sawyer 2021) and has promoted a descriptive approach to outlining the stages of CPS (Isaksen 2023). Whereas prescriptive models are normative and dictate the sequence and manner of applying CPS, descriptive approaches outline the stages as an open dynamic system (Rott et al. 2021). This promotes a more agentic role of the individual problem-solver in the CPS process who 'must construct his or her own process approach in a personally meaningful way' (Isaksen and Treffinger 2004, 89).

Rather than running through a predetermined sequence of stages, individuals need to make intentional choices and plan their journey based on what may be fit for their purposes. For example, people may need to dynamically iterate between and among the various CPS stages to explore the problem and solution space. This allows for readjusting their approach and switching from one stage to another. For example, individuals can obtain an important insight while they are engaged in developing solutions. Perhaps applying certain criteria has pointed to an area for which they need further generation of ideas or redefining the underlying problem (Lopez-Persem et al. 2024). This could also occur within a specific stage. For example, while converging during idea generation, individuals may recognize the need for further divergent generation of ideas. This sort of iteration and shifting can occur among all stages and between efforts to diverge or converge. Making these choices reflects an aspect of metacognitive control based on an ongoing monitoring of relevant task contingencies (Lebuda and Benedek 2023).

When individuals are working within any stage, they will also need to select certain tools and techniques to help them diverge or converge. Deciding which tools are appropriate to use under what circumstances, as well as when people need to switch between different tools, also requires metacognitive monitoring and control, for example, choosing tools that are more likely to produce incremental or radical options (Gryskiewicz and Taylor 2007). Following the generation of alternatives, contingencies include the quantity of the options to consider as well as the kind of convergent thinking that is required (e.g., organization, evaluation, analysis, prioritization or development). Some CPS focusing tools are more appropriate for considering a larger number of options, and others are better suited for considering a smaller number (Isaksen 2023). If a large quantity of ideas were generated, it is likely that the problem-solver could experience high cognitive load (Hernandez Sibó et al. 2024). In this case, intuitive

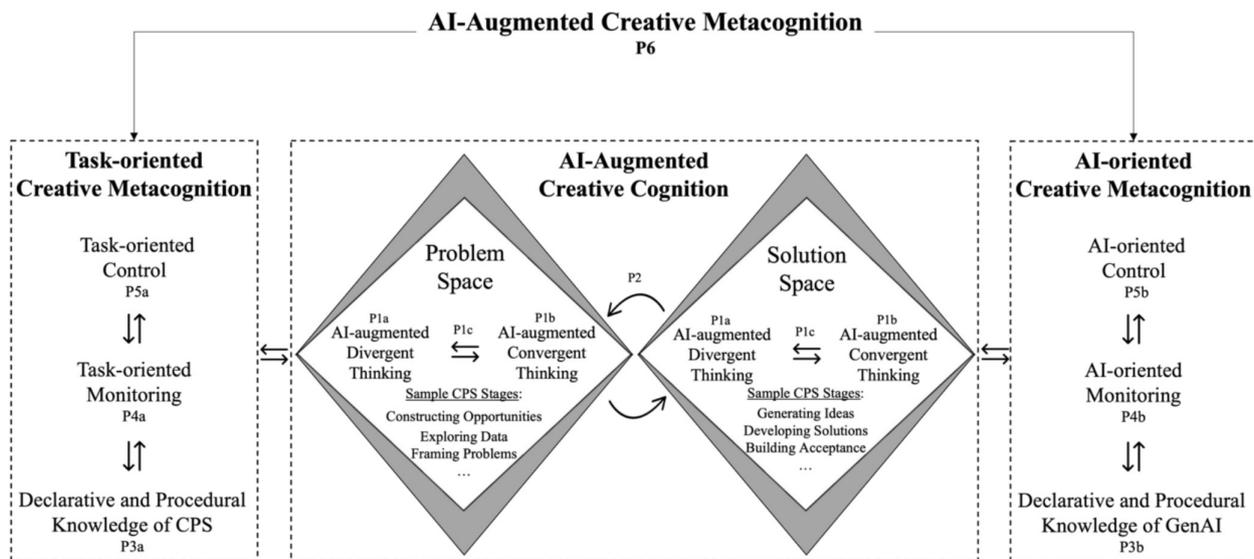


FIGURE 2 | AI-augmented creative cognition and metacognition in CPS.

rather than deliberate selection is often more practical to narrow down the options (Sukhov et al. 2021). If people have a manageable number of ideas, the reduction can also be accomplished more deliberately by sorting or clustering ideas (Tassoul and Buijs 2007). In this sense, declarative knowledge determines the range of creative thinking tools people are aware of and procedural knowledge determines the range of techniques in which people can engage in creative cognition (Pinkow 2023).

GenAI was certainly not the first technology that influenced how people approach CPS. For example, electronic brainstorming technologies and group decision support systems have a long history in assisting ideation processes (Maaravi et al. 2020). The development of numerous internet-based and software resources also proliferated during the 1990s. For example, Isaksen et al. (1994) identified more than a few dozen software resources designed to support the various stages of CPS. None of these are available today as they have been replaced by newer technology. Similarly, we currently see a proliferation of different tools that build on the capabilities of GenAI to automate or augment specific tasks such as generating or evaluating ideas that are explicitly or implicitly linked to different stages of CPS. Although technology coemerged with approaches to CPS, the development of GenAI is, so far, the most transformative technology as it goes beyond an application as a mere tool.

### 3 | AI-Augmented Approaches to CPS

Artificial intelligence broadly refers to the ability of machines to perform tasks and solve problems in a way that people would consider as ‘intelligent’ in human problem-solving (Wingström et al. 2022). Performing a broad set of these cognitive functions completely independently would characterize strong or general AI that remains, at least currently, science fiction as most ‘intelligent’ systems mimic human intelligence in narrow domains and need human input to perform or augment specific cognitive

functions such as those related to creative thinking (Marrone et al. 2024).

Following this notion, we focus on GenAI in this article as a specific form of weak or narrow AI that can provide human-like responses to natural language prompts (Schellaert et al. 2023) and, therefore, enables a new form of hybrid problem-solving (Raisch and Fomina 2024). This makes it distinct from previous technologies such as electronic brainstorming tools (Maaravi et al. 2020) as it goes beyond the application as a mere tool but is also capable of interacting and collaborating as an actor in the process by taking on different roles such as a personal assistant, a brainstorming partner, or a potential customer (Anthony et al. 2023; Boussioux et al. 2024).

The key argument proposed in this article is that the augmentation of cognitive processes in CPS with GenAI places unique metacognitive demands on people. As displayed in Figure 2, we argue that the flexible capabilities of GenAI require a distinction between task- and AI-oriented metacognition. Finally, GenAI imposes not only metacognitive demands but can also augment metacognitive processes in CPS. Each of the propositions that are displayed in Figure 2 is described in detail below.

The emerging literature on GenAI and creativity is dynamically evolving and already includes many examples of AI-augmented creative cognition in CPS. Creativity is often defined from a product perspective as the generation of novel and useful ideas (Runco and Jaeger 2012). As a result, it is not surprising that most scholars focused so far on understanding the impact of GenAI on idea generation (e.g., Bouschery et al. 2024; Haase and Hanel 2023; Meincke et al. 2024). As a complement, other scholars explored applications of GenAI for evaluating ideas (e.g., Du 2023; Just et al. 2024). Although there is less research attention on other stages of CPS, there are also examples of applying GenAI in constructing opportunities such as recognizing entrepreneurial opportunities (Truong et al. 2023); identifying, framing and

defining problems (Garbuio and Lin 2021); exploring data such as detecting patterns in large datasets (Shukla 2024); or making sense out of qualitative data such as user interviews (Morgan 2023). There are also examples of GenAI applications for developing solutions such as prototyping ideas (Bilgram and Laarmann 2023) and building acceptance for ideas from potential users and relevant stakeholders (Stige et al. 2024).

Although these examples show potential applications of GenAI to augment creative cognition in exploring the problem and solution space across different stages of CPS, scholars are still debating how GenAI can be most effectively applied to augment divergent and convergent thinking as key elements within human creative cognition. For example, Raisch and Fomina (2024, 6) recently defined hybrid problem-solving as ‘a search process that organizations use to solve problems by combining human and artificial intelligence’ and argued that AI can facilitate the breadth and depth of the search for potential problem definitions and solutions, whereas humans provide direction for the process and select the best solutions. This is what Bouschery et al. (2023) described as enlarged problem and solution space in their discussion of the AI-augmented double-diamond model, a logic that we adopted with the enlarged diamond shapes in Figure 2 to visualize the dynamics between AI-augmented creative cognition and metacognition in CPS.

However, there are also more critical perspectives on the potential of GenAI to facilitate divergence, which is often seen as the driving force of novelty. For example, chances are very low that GenAI on its own broadens the search space with ideas that are ‘new to the world’ or at least recognized as original by experts in the fields that is in line with what Kaufman and Beghetto (2009) defined as pro and big C creativity (Marrone et al. 2024). Thus, some scholars see limited potential in GenAI for facilitating divergence or argue that relying too much on GenAI may even hinder innovation by decreasing the likelihood of coming up with radically new or paradigm-breaking ideas, as GenAI builds only on the recombination of existing knowledge (Cropley and Cropley 2023; Doshi and Hauser 2024). This paradigm-breaking level of creativity happens only rarely and takes time to develop (Kaufman and Beghetto 2009). However, GenAI is likely to come up with ideas that bring new insights for people or that laypeople would consider as novel or original (Haase and Hanel 2023; Ivcevic and Grandinetti 2024). This fits Kaufman and Beghetto’s (2009) notion of mini or little c creativity, which refers to an everyday level of creativity. On that everyday level of creativity, augmenting brainstorming sessions with GenAI can significantly increase individual creative performance (Bouschery et al. 2024). Thus, in the context of our focus on individual engagement in CPS, we propose that AI-augmented divergent thinking has the potential to broaden the search space in each CPS stage.

**Proposition 1a.** *Augmenting divergent thinking in CPS with GenAI broadens the search space.*

Although some scholars see more potential in GenAI to augment divergence, others are arguing for its potential to augment convergent phases of creative processes. For example, Grilli and Pedota (2024, 6) recently stated that:

In the realm of convergence, where the objective is unambiguous and pre-specified, AI and humans may even reach qualitatively similar outcomes, but the former usually do so much more effectively.

This is consistent with Guilford’s (1968) traditional understanding of convergence as moving towards a single best option. It also assumes that there are clear evaluation criteria allowing for the unambiguous identification of the best options in a particular context. Yet, this is often not the case as the evaluation of ideas in practice is often subjective and context-dependent (Hua et al. 2022). Further, ambiguity is inherent in the creative process because even if people think that they have a clear image of their desired creative outcome, it may change during the process when they discover new insights and redefine their success criteria. Thus, it is often not clear what constitutes the ‘best’ solution, which is why convergence in CPS also involves iteratively defining criteria to develop an image of potentially desirable solutions (Isaksen 2023). As GenAI lacks intention and forethought (Runco 2023), this kind of sensemaking to guide decision-making in the CPS process remains with human actors (Bouschery et al. 2023). However, this does not mean that GenAI cannot augment convergent thinking. Given its capacity to process large amounts of information, GenAI can help people to evaluate potential solutions more systematically, thus covering the available search spaces more comprehensively and in greater depth (Just et al. 2024; Raisch and Fomina 2024).

**Proposition 1b.** *Augmenting convergent thinking in CPS with GenAI deepens the search space.*

In summary, we have argued that in context of CPS GenAI can augment both divergent and convergent thinking processes, resulting in extended human abilities to generate a larger pool of potential options across different CPS stages and evaluate available options more effectively. However, people iterate frequently between divergent and convergent thinking within CPS (Isaksen 2023), and ‘frequent adjustments toward broad and deep search likely cause cognitive overload in boundedly rational humans’ (Eicke et al. 2024, 2). Based on this logic of bounded rationality, we propose that people will benefit most from a balanced augmentation of both processes with GenAI, instead of putting more emphasis on one or the other. In other words, the more options people generate with the help of AI, the more they may be overloaded with this increased amount of information (Hernandez Sibó et al. 2024) when they need to decide which options they want to pursue further. Effectively coping with this increased complexity requires the capabilities of GenAI to process large amounts of information. This does not necessarily require GenAI to make meaningful judgements on its own, but only to converge on a given pool of options through human-guided directions by initially screening, clustering and evaluating potentially promising options. There may be scenarios such as selecting from a pool of crowdsourced ideas in which it makes sense to focus primarily on augmenting the convergent processes with GenAI (Just et al. 2024). However, in the context of individual creative cognition, divergent and convergent thinking is closely intertwined (Pinkow 2023). In this sense, GenAI extends human creative capabilities to engage in both divergent and convergent thinking. This does not imply that more augmentation is always better. We rather propose that a balanced

augmentation of both types of creative cognition will be more beneficial to the individual problem-solver compared with an imbalanced augmentation of either divergent or convergent thinking due to the imposed cognitive load. The more general question regarding how much (if any) augmentation of CPS with GenAI is beneficial in a specific situation is discussed later when we elaborate on AI- and task-oriented creative metacognition.

**Proposition 1c.** *People will benefit most from a balanced augmentation of divergent and convergent thinking processes with GenAI in CPS.*

Beyond extending human abilities to engage in divergent and convergent thinking, augmenting CPS with GenAI also increases the speed of information processing (Bouschery et al. 2023; Marrone et al. 2024). Whereas generating and focusing options in different stages of CPS take human actors some time, GenAI produces the output within seconds (Wingström et al. 2022). Based on the iterative nature of creative processes (Sawyer 2021), we argue that increased speed of processing also increases the frequency of switching between different stages of CPS. For example, if people want to explore potential solutions for a given problem, they could use a GenAI tool such as ChatGPT to diverge on an initial prompt. After reviewing the first set of options, they may decide to further exploit this direction by simply asking GenAI for a broader variety of options (i.e., broadening the search space). Yet, by experimenting with different prompts, they may also explore entirely different directions. Changing the prompt also involves reframing the underlying problem (Sasson Lazovsky et al. 2025). However, it requires much more time and cognitive resources to manually diverge on multiple problem statements. Although doing this was impractical without GenAI, people can now easily get an image of how multiple potential solution spaces might look like when they experiment with different ways of framing the underlying problem. Further, although it was also impractical to systematically evaluate a large pool of options against specific criteria, GenAI enables people to experiment with different evaluation criteria (i.e., deepening the search space). In doing so, they can also decide to elaborate on multiple consideration sets and pursue more promising options in parallel for further development. In summary, we propose that GenAI enables people to switch more frequently between different CPS stages based on their perceived need for further broadening or deepening the problem and solution space.

**Proposition 2.** *Augmenting CPS with GenAI leads to more frequent switching between different CPS stages.*

So far, we have discussed how GenAI influences the scope and dynamics of divergent and convergent thinking within creative cognition. By nature of the technology, AI-augmented divergence and convergence depend on the human input in the form of prompts to provide direction (Raisch and Fomina 2024). Further, ‘as AI cannot work intentionally or consciously, humans are required to interpret, develop, and create meaning for the outcomes that AI produces’ (Wingström et al. 2022, 12). This imposes metacognitive demands on people as individual problem-solvers (Tankelevitch et al. 2024) and, because of

dealing with these demands, shifts a part of human attention away from the cognitive to the metacognitive processes in CPS. Further, we argue that the new dynamics of AI-augmented creative cognition add a new dimension to creative metacognition as they require not only task but also AI-oriented metacognitive knowledge, monitoring, and control.

First, the metacognitive demands resulting from the augmentation of creative cognition with GenAI require that people have more declarative and procedural knowledge about CPS. This is the foundation to clearly translate the perceived demands of the task into prompts and accurately evaluate the options proposed by GenAI (Gmeiner et al. 2023). It also requires more self-knowledge to assess how GenAI may help to extend own creative strengths or cover weaknesses. Without this knowledge, people may struggle in keeping up with the increased speed of information processing and may not realize when the interaction with GenAI led them in a wrong direction so that they fail to adapt their approach to CPS accordingly. Further, AI-augmented creative cognition requires people to make their tacit knowledge explicit to formulate clear instructions for what they need from GenAI. Thus, all else equal, people with more declarative and procedural knowledge about CPS should be better able to actualize the potential of AI-augmented creative cognition.

**Proposition 3a.** *Augmenting creative cognition in CPS with GenAI requires more declarative and procedural metacognitive knowledge about CPS processes, compared with engaging in CPS without GenAI.*

In addition to task-oriented metacognitive knowledge, augmenting CPS with GenAI requires AI-oriented metacognitive knowledge as a second dimension. When appraising a task, being able to assess available technological resources becomes a key contingency for planning AI-augmented approaches to CPS. This requires an extended theoretical (i.e., declarative) and practical (i.e., procedural) knowledge compared with engaging in CPS without GenAI. For example, declarative knowledge includes knowing about the functions of available GenAI tools to assess their strengths and weaknesses for different tasks and operations within CPS. It also requires contextual knowledge regarding the relevance of different concerns about using GenAI in a particular context such as data security issues. Procedural knowledge includes knowing about how people can interact with GenAI such as the basic functions of transformer-based language models or the technical aspects of how they can write effective prompts. Without this extended metacognitive knowledge base, people have limited capacities to monitor and control their AI-augmented approach to CPS and cannot actualize the full potential of GenAI. For example, there is already empirical evidence that knowledge about prompt engineering influences how effectively people can use GenAI in creative processes (Dell’Acqua et al. 2023; Weber et al. 2023).

**Proposition 3b.** *Augmenting CPS with GenAI requires declarative and procedural metacognitive knowledge about GenAI technologies.*

Second, even in common approaches to CPS without GenAI, there is no shortage of tools and techniques reflecting the

complexity of multiple possible approaches to CPS that people may take (Isaksen and Treffinger 2004). Thus, task-oriented metacognitive monitoring builds the foundation for steering people's attention within CPS processes based on their perceived need for broadening or deepening the problem or solution space at any particular point in time. The metacognitive demands imposed by the increased speed and amount of processed information in AI-augmented creative cognition require more task-oriented monitoring to appraise the extent to which the current approach to CPS is still on track or needs to be adapted. For example, the interaction with GenAI may take people in entirely different directions, which they may experience as inspiring or distracting in different situations. Yet, for each iterative cycle of prompting and reviewing the output of GenAI, people need to reflect on where they currently stand in relation to what they want to achieve, requiring task-oriented monitoring (Tankelevitch et al. 2024). Thus, we propose that the ability to accurately monitor task-oriented contingencies enables people to better actualize the potential of AI-augmented creative cognition.

**Proposition 4a.** *Augmenting CPS with GenAI requires more task-oriented metacognitive monitoring, compared with engaging in CPS without GenAI.*

Beyond monitoring relevant task contingencies, people also need to monitor their interactions with GenAI, adding another dimension of metacognitive monitoring in AI-augmented CPS. Although GenAI is not the first technology to support this process, previous technologies such as electronic brainstorming tools were not able to respond to natural language prompts and, thus, more specialized to support specific tasks such as generating or evaluating options with a need for people to execute the application of the tool. As a result, applying the tool required constant human involvement in creative cognition. In these cases, only task-oriented monitoring was required to appraise the effectiveness of using either analogue or digital tools. The unprecedented capabilities of GenAI go beyond the application as a mere tool and have the potential to augment human creative abilities more holistically by acting as a collaboration partner (Anthony et al. 2023; Boussioux et al. 2024). For example, people can decide to specialize and outsource specific tasks such as information search entirely to GenAI, to ask GenAI to refine human-generated content or to teach GenAI to refine its own content (Dell'Acqua et al. 2023; He et al. 2023). This illustrates that GenAI can engage in autonomous, sequential or interactive problem-solving (Raisch and Fomina 2024), which does not necessarily require *simultaneous* human involvement in the *same* cognitive processes. In this regard, GenAI can take on different roles such as a personal assistant or a cocreative partner, which adds a collaborative element to individual CPS processes. As a result, people need not only to continuously monitor different task contingencies but also how they interact with GenAI and which role it should take on in the process.

**Proposition 4b.** *Augmenting CPS with GenAI requires AI-oriented metacognitive monitoring.*

Third, augmenting CPS with GenAI also requires an extended approach to metacognitive control. As described earlier, metacognitive monitoring and control are inextricably linked. For

example, people may perceive difficulty in coming up with new ideas, and after reflecting on this experience based on their metacognitive knowledge, they decide to use a different creativity technique as a tool to facilitate their divergent creative cognition. In doing so, they refocus their attention on their metacognitive monitoring.

GenAI as a tool can mimic and augment creativity techniques such as prompting ChatGPT to use morphological synthesis for exploring different options like in the pizza-making example above. There are also more specialized creative thinking tools that offer prespecified functions such as providing suggestions for questioning assumptions of the underlying problem to augment human creative thinking without the need to write an explicit prompt (Maiden et al. 2022). In this regard, the growing number of available GenAI tools increases the range of metacognitive strategies that people can apply, if they have the declarative and procedural metacognitive knowledge of these tools. Yet, making these choices also imposes metacognitive demands on people as some of them may be applied more effectively than others to augment specific types of creative thinking. For example, Grilli and Pedota (2024) proposed that linear (vs. erratic) creative processes will benefit most from AI augmentation because of streamlining the complex human-machine interactions. Yet, intuitive approaches to creative thinking may be better suited in some circumstances (Matzler et al. 2014). Therefore, based on their ongoing monitoring of relevant task contingencies, people need to constantly control when it is appropriate to augment CPS with GenAI and, if so, which tools may work best for whom under what circumstances (Isaksen 2023).

**Proposition 5a.** *Augmenting CPS with GenAI requires more task-oriented metacognitive control, compared to engaging in CPS without GenAI.*

In addition to task-oriented control, people also need to decide how they want to collaborate with GenAI as an actor in the CPS process. For example, in context of sales agents, Jia et al. (2024) found that outsourcing some elements of people's work to GenAI assistants (i.e., identifying and calling potentially interested customers) increased the creativity that people exhibited in their daily work. This only resulted if they were skilled enough to keep up with the more complex cognitive processing. In context of crowdsourcing ideas for circular economy business opportunities, Boussioux et al. (2024) found that interactive problem-solving with GenAI as a cocreative partner yielded better results than letting GenAI work on its own after an initial prompt. In context of consulting, Dell'Acqua et al. (2023) found that both sequential and interactive search could improve CPS performance but that knowledge workers with access to GenAI also made more mistakes when tasks were more ambiguous. In summary, this illustrates that there is no universally effective strategy for collaborating with GenAI in CPS and that AI-oriented metacognitive control is required to adapt the collaboration strategy to the respective situation and switch between different collaboration roles in the process if necessary.

**Proposition 5b.** *Augmenting CPS with GenAI requires AI-oriented metacognitive control.*

So far, we have argued how the augmentation of creative cognition with GenAI leads to an increased volume and speed of information processing that imposes metacognitive demands on people, which become manifest in an increased need for both task- and AI-oriented metacognitive knowledge, monitoring and control. Beyond that, GenAI can also be used to augment metacognitive processes in CPS.

This is still an emerging research area, but there are already some examples of AI-augmented metacognition in the literature on human-computer interaction, where the idea of technology-supported metacognition is not new (Bentvelzen et al. 2022). For example, Tankelevitch et al. (2024) argued that GenAI can support user's metacognition by making suggestions for planning activities such as decomposing tasks or asking reflective questions that facilitate metacognitive monitoring. Yang et al. (2024) discussed a tool that provided real-time visual biofeedback of the emotions of designers to support their metacognitive monitoring. Yang and Xia (2023) argued in a similar direction when they discussed how AI-driven educational support systems can enhance student's metacognition by providing more real-time responsiveness, for example, by evaluating facial expressions. Yeo et al. (2024) used GenAI to implement self-reflection nudges in context of online deliberation platforms. In summary, this supports the notion that GenAI can augment metacognition by providing information (i.e., extending the metacognitive knowledge base), reflective questions to increase awareness of cognitive processes (i.e., metacognitive monitoring) and suggestions for adapting the current approach to a task or problem (i.e., metacognitive control).

In this sense, GenAI can take on the role of a mentor or coach that guides people through the CPS process. Zha et al. (2024) tested a prototype of such an intelligent agent with middle school students and found that it improved their engagement in CPS as well as the quality of the generated outcomes. In other words, 'such application of AI tools can augment human creativity not by providing ideas, but strengthening the process by which human ideas are developed and built into tangible outcomes' (Ivcevic and Grandinetti 2024, 3). Based on the technological potential and the emerging evidence from prototypical applications, we propose that GenAI can extend people's metacognitive knowledge of both CPS and GenAI, as well as support people in monitoring and controlling their progress in solving the problem and how they interact with GenAI. For example, if people repeatedly prompt GenAI for generating ideas, it could ask if they have a sufficiently clear understanding of the underlying problem and provide suggestions for how they could further explore the problem space or ask them to reflect about which role GenAI should take on in the CPS process.

**Proposition 6.** *GenAI can augment both task- and AI-oriented creative metacognition in CPS.*

In summary, the propositions that are shown in Figure 2 describe the potential of augmenting creative cognition and metacognition in CPS with GenAI. The core of our proposed arguments is that augmenting creative cognition with GenAI also imposes metacognitive demands that need to be addressed to better actualize the creative potential of GenAI. This opens up

new directions for future research to enhance our understanding of AI-augmented CPS.

#### 4 | A Vista for Future Research on AI-Augmented CPS

The transformative capabilities of GenAI are changing the way people approach problem-solving and creativity (Boussieux et al. 2024; Raisch and Fomina 2024). We contribute to the emerging field of research at the intersection of GenAI and creativity by taking a metacognitive perspective on AI-augmented CPS. The theoretical framework proposed in this article links AI-augmented creative cognition and metacognition and opens up four promising themes for future research: (i) exploring the potential and risks of AI-augmented creative cognition in CPS, (ii) understanding and (iii) addressing the metacognitive demands of AI-augmented creative cognition in CPS and (iv) exploring individual differences and situational contingencies within organizational contexts. Table 1 includes sample research questions and empirical approaches for exploring each of these themes that we describe in more detail below.

First, regarding AI-augmented cognition, we proposed that GenAI broadens and deepens the search space in each CPS stage. So far, most empirical research on AI-augmented creative cognition focused on generating ideas as potential solutions to a given problem statement (e.g., Bouschery et al. 2024; Dell'Acqua et al. 2023; Dell'Acqua et al. 2025). This enables a controlled and focused investigation of the potential of AI-augmented creative cognition for exploring the solution space, but we also need more comparative research on exploring the problem space as distinct set of activities in the CPS process (Magistretti et al. 2025). For example, randomly assigning participants to experimental conditions in which they need to generate multiple problem statements (vs. ideas as solutions to a given problem statement) and to select the most promising options from this pool of alternatives with and without GenAI. This line of inquiry would enrich our understanding of AI-augmented creative cognition across different stages of CPS.

Within this line of experimental research, scholars should also explore if a balanced augmentation is indeed most effective as we proposed in this article. For example, they could compare different combinations of balanced and imbalanced augmentation of divergent and convergent thinking with non-augmented control groups. In doing so, experimental tasks should involve not only divergent (e.g., idea generation) and convergent (e.g., idea selection) tasks in isolation but rather in combination.

To explore the potential of AI-augmented cognition more comprehensively, we also need to know more about how different types of creative cognition such as adapting, transferring, combining and abstracting ideas (Pinkow 2023) can be effectively augmented with GenAI. Further, since the seminal work of Wallas (1926), we know that creative cognition involves not only conscious but also unconscious processing and that incubating on ideas improves creative performance (Liu et al. 2023). Thus, we need to better understand how the increased speed of processing with GenAI affects the frequency and quality of incubation in AI-augmented creative cognition pointing towards

**TABLE 1** | Promising directions for future research on AI-augmented CPS.

Research themes	Sample research questions	Potential empirical designs
Exploring the potential of AI-augmented creative cognition in CPS	<ul style="list-style-type: none"> <li>• What are the similarities and differences of AI-augmented creative cognition across different stages of CPS?</li> <li>• What are the implications of a balanced vs. imbalanced augmentation of divergent and convergent thinking with GenAI? Are these patterns similar across different CPS stages?</li> <li>• To what extent can GenAI augment different forms of creative cognition? What are the potential negative consequences such as a reduced range of applied creative thinking tools and techniques, or shorter periods of incubation?</li> </ul>	Combining experimental research designs on <i>bounded CPS tasks</i> requiring divergent and convergent creative cognition in different stages of CPS with microlongitudinal and neuroscientific approaches to capture the intraindividual dynamics of AI-augmented creative cognition
Understanding the metacognitive demands of AI-augmented creative cognition in CPS	<ul style="list-style-type: none"> <li>• How frequently do people switch between exploring the problem and solution spaces with and without GenAI, and how do they navigate between different stages of CPS?</li> <li>• How do people switch between different roles and collaborative search practices when interacting with GenAI in CPS?</li> <li>• How does the design of GenAI technologies influence the imposed metacognitive demands in the context of CPS?</li> </ul>	Combining experimental research designs on <i>open-ended CPS tasks</i> with qualitative approaches such as think-aloud protocols or diaries to explore how people engage in AI-augmented creative cognition, collaborate with GenAI as an actor and switch between CPS stages
Addressing the metacognitive demands of AI-augmented creative cognition in CPS	<ul style="list-style-type: none"> <li>• How can GenAI augment metacognitive knowledge, monitoring and control, and what are the potential negative consequences such as becoming dependent on the technology?</li> <li>• How do prompt engineering interventions influence how people engage in AI-augmented creative cognition?</li> <li>• Which training approaches (e.g., sequential with and without GenAI or integrated) are most effective to learning how to engage in AI-augmented CPS?</li> </ul>	Combining experimental research designs on <i>open-ended CPS tasks</i> with interventions and longitudinal designs using different approaches to augmenting creative metacognition with GenAI and developing metacognitive knowledge, skills and abilities
Exploring individual differences and situational contingencies in organizational contexts	<ul style="list-style-type: none"> <li>• For which purposes, for whom and under what circumstances does GenAI add most value for engaging in CPS in organizational contexts?</li> <li>• How does GenAI influence group dynamics and social metacognition between AI and human actors in collaborative CPS?</li> <li>• How does augmenting collaborative CPS with GenAI change established approaches to facilitating creative processes in groups?</li> </ul>	Combining field-experimental research on <i>representative CPS tasks</i> with mixed-methods approaches to triangulating different sources of data such as linking individual perceptions with objective performance measures, or observations of group dynamics

potential negative effects of GenAI on internal creative processes (Aru 2025). We also know from early creative process theories that intellectual illumination and emotional catharsis are inextricably linked (Koestler 1964). For example, emotional states influence how people engage in CPS (Langley 2018; Montag-Smit and Keith 2023), and affective shifts from negative to positive emotions are associated with higher creative performance (Bledow et al. 2013). As emotions are still uniquely human, future research is needed to explore the influence of emotions on how people can effectively collaborate with GenAI in CPS. A promising empirical pathway to capture these intraindividual differences is a combination of the experimental research tradition in cognitive science with microlongitudinal and neuroscientific approaches to creativity research (e.g., Abraham 2018; Beghetto and Karwowski 2019).

Second, we proposed that the increased volume and speed of information processing and the complexity of collaborating with GenAI as an actor in AI-augmented creative cognition impose metacognitive demands. However, experimental research designs on bounded CPS tasks do not provide insights into the kind of switching between the problem and solution space that we proposed in this article. More specifically, a bounded CPS task such as generating ideas on a clearly defined problem statement limits the number of metacognitive strategies that people can apply as they only need to focus on exploring the solution and not the problem space (Reiter-Palmon et al. 2024). Thus, these bounded CPS tasks impose less cognitive load on people but also limit the range of metacognitive monitoring and control that can be observed during task engagement (Hernandez Sibó et al. 2024). Therefore, we suggest to use open CPS tasks that allow for observing how people engage in creative metacognition to switch between exploring the problem and solution space.

Further, it will be helpful to build on the experimental designs and established measures in the existing research on creative metacognition such as the metacognition in CPS scale developed by Urban and Urban (2023b). In addition, we also need more qualitative approaches such as think-aloud protocols (e.g., Berardi-Coletta et al. 1995; Sowden et al. 2020) to gain a better understanding of how people interact with GenAI in CPS in different roles and switch between different collaborative search practices. In doing so, it would be promising to capture the actual prompts that people used to interact with GenAI and experiment with different types of AI-augmented CPS tools. For example, some tools try to augment analogue CPS tools with GenAI (Maiden et al. 2022) and require less input in the form of prompts and, therefore, may also impose less metacognitive demands compared with chatbots such as ChatGPT that offer more flexible applications but also require more human direction. Tools that offer augmented cognition in real time (often called ‘co-pilots’) such as autofill options or suggestions for ideas when writing a text or brainstorming ideas on a virtual whiteboard reflect a combination of both other types of tools (Tankelevitch et al. 2024).

Third, we also need to better understand how the metacognitive demands of AI-augmented creative cognition can be addressed to better actualize the creative potential of GenAI. Similar to understanding the metacognitive demands, we suggest that research on addressing the metacognitive demands

should focus on experimental designs with open-ended CPS tasks. However, for advancing our knowledge on how people can address the metacognitive demands, scholars should combine these open-ended tasks with interventions that focus on either augmenting creative metacognition with GenAI or training people to engage in AI-augmented CPS. For example, experimental study designs could include micro interventions such as the creative self-regulation prompts used by Zielinska et al. (2025) to explore how people react to human and AI-generated prompts when they are engaged in AI-augmented CPS. Besides augmenting creative metacognition with GenAI, scholars could also compare the effectiveness of interventions that aim to enhance people’s metacognitive knowledge, skills and abilities to interact with GenAI such as the prompt engineering instructions used by Dell’Acqua et al. (2025). In addition to these types of focused interventions, future research should also explore with longitudinal designs how established approaches to creativity training (e.g., Isaksen 2023; McKay et al. 2024; Puccio et al. 2006) need to be extended or adapted to develop the metacognitive knowledge, skills and abilities for effectively engaging in AI-augmented CPS. For example, similar to Puccio et al. (2020), scholars could compare how people with no, some and more advanced training in CPS engage in AI-augmented CPS. Further, this line of inquiry could compare different approaches to training people in CPS with and without GenAI such using a sequential (training people in CPS before they learn to use GenAI) or integrated (combining CPS training with GenAI) approach.

Fourth, beyond isolated investigations of the cognitive and metacognitive processes, we also need to gain a better understanding of their context and boundary conditions. Based on systems theories of creativity (Hennessey 2017), a guiding question in contemporary approaches to CPS is what works for whom under what circumstances (Isaksen 2023). Building on this, future research should explore relevant individual differences and situational contingencies influencing how people engage in AI-augmented CPS when working on *representative* tasks in organizational contexts. For example, we know that people have individual style preferences for how they engage in CPS that also influence how they collaborate with each other (Main et al. 2019). On a group level, people engage in social metacognitive monitoring and control (Halmo et al. 2022; Richardson et al. 2023) to create a shared understanding of social roles and collective practices, which is typically supported by a process facilitator (Wróbel et al. 2021). In this regard, it is likely that AI-augmented approaches to CPS will extend our contemporary understanding of facilitation by requiring not only facilitation of the collaboration among human actors but also between human actors and GenAI. Thus, we need to know more about how the proposed dynamics of task- and AI-oriented metacognition extend to the group level. Adding group dynamics to the experimental designs described above would be a natural next step in moving forward. Dell’Acqua et al. (2025) recently provided an example of a field-experimental study suggesting that GenAI can compensate for some benefits of teamwork in collaborative CPS. Similar to this example, future studies in this direction should triangulate different sources of data such as individual perceptions, objective performance measures and observations of group dynamics to gain a more holistic understanding of AI-augmented CPS in organizational contexts.

It is important to note here that our framework and the future research directions discussed above are, by no means, exhaustive. Rather, our framework should be regarded as a first attempt to understand AI-augmented CPS not only from a cognitive but also from a metacognitive perspective. Although our propositions are grounded in theory and the emerging literature on AI and creativity, they still need empirical validation. In this regard, we echo Von Krogh's (2018) call for a phenomenon-driven theorizing of GenAI in CPS as a new phenomenon. Similar to the integration of metacognitive elements within contemporary CPS frameworks resulting from reflective practice (Isaksen and Treffinger 2004), understanding AI-augmented approaches to CPS should also be informed by reflective practice. Moving in this direction, scholars could build on the guidelines recently offered by Cornelissen (2023) to gain a more holistic understanding of phenomena by triangulating propositional, configurational and process theorizing.

Despite these limitations and the need for empirical validation, our framework also offers practical implications. Although the research on AI-augmented CPS is still emerging, many organizations are already experimenting with GenAI. Based on what we proposed in this article, AI-augmented approaches to CPS still require people to engage in creative cognition. Thus, there is still value for organizations to invest in creativity training as an effective means for developing creativity-relevant skills (McKay et al. 2024; Puccio et al. 2020). Yet, organizations also need to be aware that GenAI adds new dynamics to how people engage in CPS as it is not just another digital tool but can also take on the role of a new actor in the process. Therefore, in addition to developing creativity-relevant skills in training programs, people need to acquire theoretical and practical knowledge about how they can effectively collaborate with GenAI in CPS. By encouraging reflective experimentation, organizations can signal employees where it is safe to try GenAI and build metacognitive knowledge by reflecting on these experiences.

## 5 | Conclusion

GenAI is transforming the way people approach CPS. Yet, the most likely future will still not be dominated by machines thinking creatively. At least currently, intentional thought and emotional experience in machines are still science fiction and remain uniquely human. However, at the same time, GenAI is already able to mimic some aspects of human creative thinking and match or even exceed human performance on bounded tasks such as generating potential solutions for a particular problem. Therefore, augmenting CPS with GenAI has the potential to extend human creative abilities. Yet, as we have shown in this article, the increased speed and volume of information processing in AI-augmented creative cognition and the collaboration with GenAI as an actor in the CPS process also impose metacognitive demands that have been widely overlooked so far. Managing these demands has important implications for how people can better actualize the creative potential of GenAI. AI-augmented approaches to CPS are still an emerging phenomenon, and much work remains to be done to improve our understanding of it. We hope that the framework presented in this article will stimulate future research in this regard and help to guide reflective practice in experimenting with the technology.

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Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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