

Pinkow, Felix

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SPECIAL ISSUE ARTICLE

Creative cognition: A multidisciplinary and integrative framework of creative thinking

Felix Pinkow 

Chair of Technology and Innovation
Management, Technische Universität Berlin,
Berlin, Germany

Correspondence

Felix Pinkow, Chair of Technology and
Innovation Management, Technische
Universität Berlin, Straße des 17. Juni
135, 10623 Berlin, Germany.
Email: felix.pinkow@tu-berlin.de

Extant research provides vast information on antecedents to creativity. However, creative thinking is oftentimes treated as a black box, requiring input and producing creative output. Cognitive processes occurring during creative thinking tend to be neglected, although they can provide a bridge between the inputs to creativity and the resulting outputs. Literature offers different perspectives on creative thinking processes, such as the separation of divergent and convergent thinking, different stages of creativity or the concept of creative cognition. This variety of concepts underlying creativity has led to confusion and misinterpretations of some concepts. Moreover, the overemphasis on creative outcomes and divergent thinking has resulted in a neglect of a more comprehensive view on cognitive dimensions of creativity. Through reviewing and synthesizing multidisciplinary literature on creativity, an integrative framework is developed positioning cognitive elements of creativity within a system including organizational antecedents to creativity and creative outcomes. The framework seeks to offer pathways to increasingly incorporate the concept of creative cognition into future research. Suggesting different forms of creative cognition that individuals engage in during creative thought, this theoretical work further offers a theoretical development of creativity concepts that intends to inspire future research designs and facilitates cross-disciplinary knowledge transfer.

KEYWORDS

cognitive processes, conceptual framework, creative cognition, creativity, divergent and convergent thinking, idea generation, literature review

1 | INTRODUCTION

Innovation is considered a cornerstone of a firm's success and competitiveness (Salomo et al., 2007), and as such creativity, a central component of innovation, is a fundamental asset for innovation (Amabile & Pratt, 2016; Anderson et al., 2014; Bergendahl et al., 2015). Research in innovation management offers a vast amount of studies determining antecedents to creativity, such as leadership (Caniëls et al., 2014; Scott & Bruce, 1994), psychological aspects (Amabile, 2017) organizational resources (Caniëls et al., 2014) or individual creative abilities

(Scott & Bruce, 1994; Tierney & Farmer, 2002). While knowledge about these factors is central to the ability of organizations to influence and facilitate employee creativity, there is still a lack of understanding of the underlying creative thinking processes. As creative thinking itself is essentially a cognitive process (Mensel, 2004), antecedents to creativity and cognitive processes underlying creative thinking form an expedient relationship. A profound understanding on how cognition relates to creative thinking and its antecedents facilitates the decision which actions managers can take to foster creative thinking and which potential cognitive barriers must be addressed.

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However, in particular, organizational research focuses on antecedents to creative performance (Anderson et al., 2014; Caniëls et al., 2014) and tends to assess creativity ex-post, after ideas have been generated (e.g. Im et al., 2013; Nakata et al., 2018). Undoubtedly, this research approach has proven useful in identifying the central factors that shape creativity, in terms of creative outcomes. The downside of this ex-post approach is that it factors out the creative process itself, treating creative thinking as a black box that requires input and produces measurable output. In fact, recent literature highlights that the prevalent overemphasis on creative output neglects the importance of researching the underlying creative processes (Fortwengel et al., 2017; Sonenshein, 2016).

The complexity of researching creative thinking processes lies not only in the difficulty to observe what happens in the minds of individuals but also in the multidisciplinary nature of creativity, resulting in a plethora of different conceptualizations. Organizational research on creativity tends to offer a procedural perspective by distinguishing creative stages or phases (e.g. the dynamic componential model of creativity of Amabile & Pratt, 2016). This perspective assigns a series of distinct but interrelated goals to creativity, such as perceiving, observing and identifying a problem, developing solutions or generating and evaluating ideas. Research in cognitive psychology offers several perspectives on creativity. For one, it offers insight into cognitive thinking processes relevant to creativity, whereby two widely distributed prototypical forms of creative thought have emerged that are divergent and convergent thinking (Benedek & Fink, 2019; Guilford, 1967). Alternatively, cognitive psychology also offers the concept of creative cognition, which refers to the cognitive processes individuals engage in during creative thought (Benedek & Fink, 2019; Ward, 2007; Ward et al., 1995). In particular, there are different forms of creative cognition, such as recombining existing knowledge or expanding existing knowledge through novel insight (Ward, 2007; Ward et al., 1995).

Research on creativity across all disciplines experienced significant growth, and regardless of the particular discipline, their common object of interest is creativity. Yet, studies on creativity tend to remain within their respective discipline and focus, for instance, on either organizational characteristics that are relevant to creativity or on cognitive dimensions of creativity. For example, Hughes et al. (2018) find an overemphasis on motivational processes in organizational research in the context of how leadership can influence creativity, while cognitive aspects remain understudied. In contrast, research focusing on cognitive processes offers insight into *how* creative outcomes are achieved but often lacks the ability to relate cognitive processes to an organizational context (e.g. Hagtvædt et al., 2019; Reiter-Palmon & Murugavel, 2018). In attempts to explain creative thinking processes, creativity has been increasingly viewed through a cognitive lens in management research. This has, however, led to conceptual misunderstandings. In particular, the importance of the role of divergent thinking for creativity is argued to be unrealistically inflated (Runco, 2015). But even more problematic are misunderstandings in adopting the concept of divergent thinking in management research. The concept of divergent thinking became so widespread that it even has been treated synonymously to creativity (Piffer, 2012; Runco, 2012). On

the one hand, from a theoretical perspective, this false understanding makes it difficult to compare studies on creativity that are not fully transparent on how creativity is conceptualized. On the other hand, this misunderstanding is even more concerning from a managerial perspective. As studies that misunderstand concepts of creative thinking derive managerial implications based on false premises with respect to the underlying theoretical concepts, the derived managerial advice may not hold true in practice or may even mislead practitioners into applying wrong measures to stimulate creativity.

Thus, this work seeks to clarify the conceptual underpinnings of creativity from a managerial perspective and outline the relationships between creative process models from organizational research and concepts from cognitive psychology on creative thinking processes. On the basis of the integration of cross-disciplinary creativity concepts, a conceptually refined framework of creative thinking is suggested that connects central organizational aspects, such as leadership as antecedent to creativity, with cognitive dimensions of creativity. This conceptual cross-disciplinary integration can facilitate knowledge transfer among creativity researchers and disciplines and offers guidance for understanding the various terms and concepts that are increasingly used in organizational research on creativity.

From a theoretical perspective, the envisaged integrative framework conceptually bridges research on antecedents to creativity and creative output by positioning a cognitive layer between input to creativity and creative output. Through a comprehensive review of literature, this work not only serves as an overview on recent developments in creativity research but also seeks to identify relationships and interdependencies across research disciplines. The framework thereby sets stage for future research to discuss empirical evidence on creativity from a multidisciplinary perspective and to position future studies accordingly in the framework. This work thus offers a route to more fine-grained analyses by taking relationships between cognitive aspects of creative thinking and organizational factors into consideration.

From a managerial perspective, there is a large pool of underutilized knowledge stemming from research in cognitive psychology that is relevant to organizations and practitioners. Creating awareness concerning which antecedents and intended outcomes of creativity relate to creative cognitive processes supports a more deliberate decision-making on actions that seek to improve creative performance of employees. An understanding of different creative cognitive processes, how individuals engage in certain cognitive processes and which potential cognitive barriers can emerge allows to stimulate creative thinking more effectively and to address certain cognitive barriers purposefully. Likewise, individuals engaging in creative thinking can equally benefit from knowledge concerning creative cognition, as the awareness of factors determining creativity on the cognitive level can be utilized to improve one's own creative performance.

2 | CREATIVITY AND COGNITION

The definition that widely finds acceptance in both innovation and creativity literature is understanding creativity as the production of

new and useful ideas (Amabile et al., 1996; Amabile & Pratt, 2016; Anderson et al., 2014; Baron, 2007; Oldham & Cummings, 1996). This definition comprises two distinct criteria—to be considered creative, an idea must be new or original *and* be useful. While the originality of an idea is undoubtedly required, the second criterion, the usefulness of an idea, is often disputed (Runco & Jaeger, 2012). Runco and Jaeger (2012) argue that originality or novelty alone is not sufficient for creativity but emphasize that creative ideas must also be effective or useful. Unique or uncommon ideas can be original but not creative given a lack of usefulness. Therefore, the understanding of creativity boils down to the assessment whether an original idea is useful and thus potentially creative, or not useful, and thus merely original.

Yet, a vast amount of research on creativity focuses on idea generation (Anderson et al., 2014), emphasizing the production of ‘the new’. Although considered a central phase of creativity, idea generation requires a goal, such as a problem to be solved or an opportunity to be addressed. In fact, ideation does not only require the discovery of a problem or opportunity, but the problem or opportunity must also be clearly identified and defined to prepare for the subsequent generation of ideas and solutions (Runco & Chand, 1995). In other words, as Ward (2004, p. 176) states, a fundamental obstacle to generate novelty is the ‘truism that one cannot produce something from nothing—*ex nihilo nihil fit*’. Hence, generating novelty requires knowledge about a problem or opportunity to be addressed. This kind of knowledge is described as declarative knowledge, referring to factual information (Runco & Chand, 1995). However, the ability to think creatively requires more than mere declarative knowledge. It also requires the knowledge about how to engage in creative thinking, which is described as procedural knowledge, or in other words ‘know-how’ (Runco & Chand, 1995).

Knowledge, both declarative and procedural, is hence a fundamental asset for creativity, and can be both facilitative and inhibitive (Runco & Chand, 1995). As creative thinking happens in the minds of individuals, it is considered a cognitive process (Cropley & Cropley, 2008; Mensel, 2004), that is, enabled through knowledge (Runco & Chand, 1995). Knowledge is a broad concept comprising various elements but at its core is information. Davenport and Prusak (2000, p. 4) define knowledge as ‘a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.’ Considering this link between knowledge and information, cognition essentially is inseparable from knowledge, and so is creativity. Taking a broader perspective, cognition refers to how individuals process, obtain, organize and store information (Cropley, 1999). The definition of cognition from the APA Dictionary of Psychology (n.d.) highlights the intertwined nature of cognition and creativity, stating that cognitions refers to ‘all forms of knowing and awareness, such as perceiving, conceiving, remembering, reasoning, judging, imagining and problem solving.’ This definition encompasses the very process of creativity—imagining, conceiving and problem-solving through perceiving a problem that requires a solution. Creative cognition hence refers to the cognitive processing of information with the goal to achieve creative outcomes. Runco and Chand (1995)

acknowledge that cognitive research on creativity can be rather non-obvious, since the underlying cognitive processes of creativity are only recognized if one is explicitly interested in understanding creativity. However, identifying these processes enhances our understanding of creative thinking itself and thus caters the purpose of refining recommendations to practitioners how to effectively foster creativity.

2.1 | The relationship between divergent and convergent thinking processes and creativity

In order to determine cognitive processes of creativity, it is pertinent to consider that creative thinking is not a unitary construct. The emergence of two separate, central concepts of creative thinking is ascribed to the works of Guilford (1967, 1970). Guilford (1967, 1970) states that the most relevant abilities for creativity can be separated into divergent and convergent thinking. Divergent thinking is understood as a broad way of thinking, including the ability to make unusual associations, and to produce a variety of original ideas through unconventional and flexible thinking (Cropley, 2006; Palmiero et al., 2020; Runco & Acar, 2012). Convergent thinking is referring to analytical, logical thinking processes, concerned with the production of one or few correct ideas instead of a broad variety (Cropley, 2006; Runco & Acar, 2012). This rather intuitive separation of creative thought into divergent and convergent thinking has also been increasingly adopted in management literature. The shortcoming of these two fundamental concepts is their broad definition (Ward, 2007), which does not offer sufficient insight into how individuals eventually achieve creative outcomes. They merely describe characteristics of different thinking processes but not the actual cognitive processes individuals engage in during creative thought (Ward, 2007). Although creativity researchers acknowledge that divergent and convergent thinking processes are both necessary for creativity (Brophy, 1998; Runco & Acar, 2012), there is still ambiguity on how these thinking processes are related to the superordinate act of creative thinking, how they interact and how to position them within the system that surrounds creative thinking.

It is particularly problematic that literature oftentimes remains vague with the understanding of what is considered an ‘idea’ or a ‘creative idea’ in this context. Regularly, divergent and convergent thinking are linked to specific outcomes from creative processes, in terms of final ideas such as solutions to a problem or the identification of a problem or opportunity to be addressed. Gielnik et al. (2014), for instance, state that identifying business opportunities is rather related to divergent than to convergent thinking. In fact, either divergent or convergent thinking processes may be dominant during creative thinking (Goldschmidt, 2016), such as in the creative process of identifying a business opportunity. However, neglecting either divergent or convergent thinking completely implicitly considers them as mutually exclusive. It relates to an understanding of divergent or convergent thinking processes to provide a *final* idea and relates one thinking process immediately to an outcome. This factors out all potential other processes that may occur between an initial input, such as an initial perception, a glimpse of what could be a business opportunity, and

the output, the identification and description of a concrete business opportunity. A final outcome is, in most cases, not the result of a single thought. As Cropley (2006) states, there might be rare instances of 'lucky hits' that may turn out as novel and useful ideas, but in a normal course of events, it is rather unlikely that a single divergent thought results in a creative idea. Instead, viewing final ideas as a construct of accumulated multiple individual thoughts offers a more logical and integrative understanding of creativity. Goldschmidt (2016) offers sound support for this perspective on divergent and convergent thinking processes. Building on literature arguing that creativity is facilitated by shifting and iterating between divergent and convergent thinking (e.g. Basadur et al., 1990; Gabora, 2010); Goldschmidt (2016) reports in her study that the shifts are so frequent that they can be considered as concurrent processes and that only their interplay results in creative outcomes.

Returning to Gielnik et al.'s (2014) example, convergent thoughts can therefore equally contribute to the very identification of a business opportunity. Logically recombining existing knowledge, which refers to converging multiple pieces of already existing information into a new piece of information, can, for instance, result in a novel opportunity but is rather to be characterized as a convergent process. Alternatively, identifying a glimpse of an opportunity in a different and distant knowledge domain may result from a divergent thought, but analysing and logically interpreting this initial perception and applying it to a task at hand is not a strict divergent process anymore. This logical, analytical process of matching an analogy with familiar knowledge can be referred to as a convergent process. The subsequent cognitive processing to understand the opportunity, to determine unique aspects and promising avenues resulting from the opportunity for the own organization, can again well be subject to divergent processes. Yet, it is only the interplay of single convergent and divergent thinking processes, or in other words *individual thoughts*, that ultimately result in a final, holistic and comprehensible definition and description of the initial thought, the perceived business opportunity.

In fact, we do not know how individuals achieve ideas and solutions without analysing their brain activities or explicitly asking them. As Ward (2007) describes along the example of the commonly used alternative use task to assess an individual's divergent thinking ability, individuals may use a broad variety of different forms of creative cognition to generate ideas. Prompting individuals to generate as many different uses for a shoe as possible, individuals may use their past experiences, may remember that a shoe has laces which can serve alternative purposes or may interpret the shoe as a container through abstraction (Ward, 2007). What is apparent from these examples, however, is that Ward (2007) implicitly relates all exemplary approaches to generate ideas in relation to existing declarative knowledge. In his examples, all forms of creative cognition require the knowledge of a shoe, that is, knowing how it looks like or being aware of its features. Taking a more general perspective, Welling (2007) argues that even the generation of fundamentally new ideas is built on top of existing knowledge. Hence, matching any novel thoughts with existing knowledge is a precursor to creative ideas. Thus, it does

not only require the mere identification of novel information but also requires the convergence of novelty with familiar knowledge and therefore, again, the interplay of divergent and convergent thoughts. This consideration links to what Toubia and Netzer (2017) call the 'beauty of averageness' in the context of creative idea generation and evaluation. Building on a theoretical proposal by Ward (1995), Toubia and Netzer (2017) find that ideas that achieve a balance of novelty and familiarity are ultimately judged as more creative.

Conflating these considerations to the initial argument that there is often a lack of a clear understanding on what is considered an idea, it is argued that ideas are the accumulation of individual thinking processes or, as such, individual thoughts. Individual thoughts in the context of creativity, in turn, are cognitive processes that aim at evaluating, perceiving, judging or interpreting novel or existing information against the backdrop of further existing knowledge. These individual thoughts can be either subject to divergent or convergent thinking processes, and their interplay can result in what is considered a 'creative idea'. The understanding of divergent and convergent thinking processes as individual thoughts, constituting the yardstick for how to relate divergent and convergent thinking processes to creativity, also offers a complementary perspective to traditional stage models of creativity.¹ The difference to established stages of creativity is the unit of time. Individual thoughts can take place for seconds or at maximum minutes. Creative stages can take place for days, weeks or even months and include a plethora of individual thoughts.

Typical stages of creative thinking that are prevalent in organizational research, for instance, include problem recognition or opportunity identification, problem definition and research, idea generation² and idea evaluation and selection (Amabile & Pratt, 2016; Lubart, 2001). It is noteworthy that these stages form an idealized process (Amabile & Pratt, 2016) and do not necessarily constitute a fixed sequence (Lubart, 2001). These stages are also found in literature on design thinking. Design thinking is a method concerned with promoting creativity (Mahmoud-Jouini et al., 2019), and hence, comparisons can be drawn to creative thinking processes. Conceptually, design thinking is separated into several stages. The double diamond model, which is rooted in design thinking, suggests four stages, starting with discovery, followed by definition, development and delivery (Discover—Define—Develop—Deliver) (Ferreira et al., 2015). These four stages resemble the four stages of creativity similarly prevalent in creativity and innovation management literature. In addition, the double diamond model further enhances these four stages (Ferreira et al., 2015; Tschimmel, 2012). The model illustrates creativity as iterating divergent and convergent stages, whereby the discovery and development stage constitute divergent stages, and the definition and delivery phase constitute convergent stages (Ferreira et al., 2015; Tschimmel, 2012).

The stages of creative thinking resembling literature on creativity and design thinking are illustrated in Figure 1. The problem with this illustration is, again, that divergent or convergent stages are seemingly linked to specific outcomes, such as recognizing a problem or generating ideas or solutions for a given problem or opportunity. As delineated above, divergent and convergent thinking may characterize

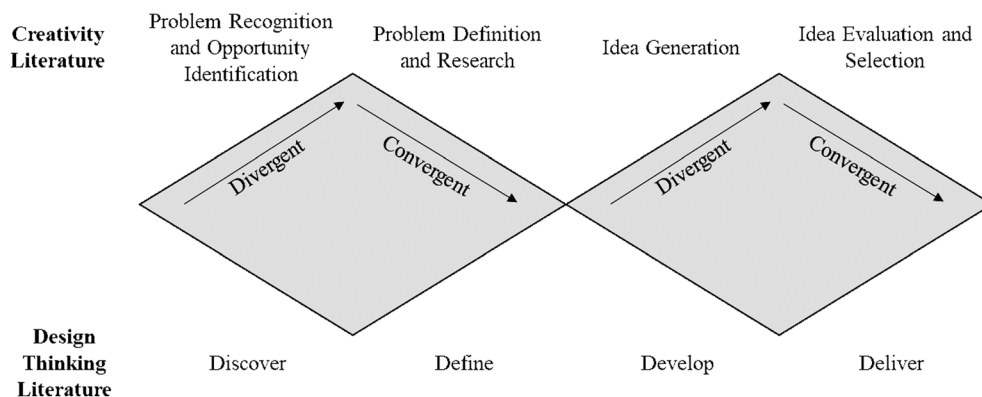


FIGURE 1 Idealized creative thinking process

individual thoughts, but they should not be considered general approaches to think creatively. Individuals do not engage in divergent or convergent thinking as distinct means for creative thinking, but individuals engage in more general forms of creative thinking. These forms comprise a range of different thinking processes that can be characterized as more divergent or convergent, whereby one can be dominant (in line with Goldschmidt, 2016), yet not exclusive to a certain stage. Moreover, design research has emphasized that in practice, design processes rarely follow the seemingly prescribed fixed sequences of creativity methods and that the design process is more erratic (Howard et al., 2008). It has further been shown that individuals engage in different strategies to approach a problem when given a similar design task requiring creativity (Dorst & Cross, 2001). Hence, to enhance knowledge on creativity, it is vital to understand the variety of approaches how individuals eventually engage in creative thinking. Applying a cognitive lens and connecting it to organizational research can thereby offer a window on how processes such as divergent and convergent thinking are embedded in more general creative approaches. This conceptual integration thereby also corresponds to calls emerging from design studies to increasingly adopt a multidisciplinary approach to creativity research (Howard et al., 2007).

2.2 | Forms of creative cognition

Instead of considering divergent or convergent thinking processes as self-reliant and individual approaches to creativity, it is reasonable to think in terms of specific forms of creative cognition that comprise both divergent and convergent processes. This understanding is rather in line with creativity researchers who consider divergent and convergent thinking as predictors for actual creativity but not as synonyms (Runco & Acar, 2012). Skills in divergent and convergent thinking enable individuals to engage in creative thinking. Extant literature provides reasonable evidence for four such distinct forms of creative cognition along a continuum determined by the share of existing or novel information being processed. In a literature review, Welling (2007) synthesizes creativity theories and empirical evidence and suggests that the central four forms of creative cognition that emerged are the *application* of existing knowledge, drawing an *analogy* from one knowledge domain to another, the *combination* of two or more

TABLE 1 Four forms of creative cognition

Forms of creative cognition	
Lassig (2013)	Welling (2007)
Adaptation: Adapting existing ideas within a particular domain through modifying, varying, manipulating or rearranging existing work.	Application: Adaptive use of existing knowledge, adaption of existing conceptual structures.
Transfer: Transferring ideas from one task or domain to another.	Analogy: Transportation of a conceptual structure from one context to another context.
Synthesis: Combining two or more existing ideas, either from the same or a different domain, whereby the combination results in novelty.	Combination: Merging of two or more concepts into one new idea, which requires creation of new conceptual structures.
Genesis: Aggregating ideas and experiences to create outcomes that are significantly different from existing work, whereby no clear source or origin of ideas can be identified.	Abstraction: New, abstract knowledge is built on top of existing knowledge, including discovery of new information.

concepts into one new idea and lastly the *abstraction* of knowledge intended to create fundamentally new knowledge. In a further study, through a grounded theory approach, Lassig (2013) similarly finds that individuals engage in creative thinking through four separate ways, which he labels *adaptation*, *transfer*, *synthesis*, and *genesis*. Illustrated and described in Table 1, both studies have come up with four comparable forms of creative cognition, one through reviewing theory and extant literature (Welling, 2007), and one provides evidence that these forms are grounded in empirical data (Lassig, 2013).

Notably, these forms of creative cognition are independent of a specific goal, as any can be used to identify a problem or opportunity, to gather information that is required to define a problem or to generate ideas. Hence, these forms do not contradict extant stage models of creativity as outlined in Figure 1 but illustrate how individuals engage in creative thought that can be utilized in any creative stage.

The first form of creative cognition, application or adaptation, results in novel ideas through incremental modifications of existing knowledge, which often occurs in everyday work processes (Welling, 2007), but may also be subject to dedicated creative processes. In design research, for instance, this may concern new restrictions or customer requirements that are addressed through altering the design of a product to match these requirements without changing too many further aspects (Eckert et al., 2012). Although the creative aspect lays in adapting an existing design in this case, design newness has been shown to be a dimension of product innovativeness (Talke et al., 2009). Hence, although not fundamentally new information or knowledge are generated, application/adaptation can result in creative outcomes. Linking this form of creative cognition to divergent and convergent thinking processes, it entails elements of both, such as divergent characteristics in terms of transforming the known and also convergent characteristics such as preserving the known while only modifying some aspects of existing knowledge or sticking to a rather narrow range of possible solutions (see Cropley, 2006). Overall, this form of creative cognition primarily deals with the modification of familiar knowledge, and thus, convergent thinking processes are indicated to be more dominant than divergent thinking processes.

The second form, transferring an idea from one (source) domain to another (target) domain, is associated with drawing analogies (Lassig, 2013; Welling, 2007). Analogies can differ in terms of the relatedness or distance of the domains among which the transfer is conducted (Bonnardel & Marmèche, 2004; Lassig, 2013; Welling, 2007). An analogy may take place within a domain, which Bonnardel and Marmèche (2004) describe as intradomain analogies, such as when a problem at hand can be solved from the experience of a previous similar problem, and the solution is transferred within the same conceptual domain. For instance, a solution that worked for a given problem for cars with combustion engines also works for a similar problem for cars with electric engines—the problem and transfer domain distance remain narrow. On the other hand, interdomain analogies transfer ideas and solutions from different conceptual source and target domains (Bonnardel & Marmèche, 2004). This may concern analogies between seemingly unrelated domains, such as the lotus effect which originated from observations in nature and was subsequently applied to various technical applications requiring self-cleaning surfaces. The discovery of a suitable source domain for an analogy is thereby more likely to be subject to divergent thinking processes, requiring the ability to perceive new possibilities and shift perspectives (Cropley, 2006). The distance between the source and target domain may additionally determine the degree of novel information being processed. Subsequently, applying the analogy is subject to adapting the solution from the source to the target domain, that is, a convergence of newly identified with existing information and knowledge between the domains.

The third form of creative cognition, combination or synthesis, differs from transfer or analogy in terms of the creation of new information (Welling, 2007). While in analogies ideas or solutions are transferred between domains, they are adapted but not fundamentally

changed. In contrast, combination or synthesis describes merging of at least two concepts into one new idea; hence, it results in a new, previously unknown piece of information or knowledge (Welling, 2007). This description is closely related to divergent thinking characteristics, such as perceiving known and familiar information in a new light or being unconventional (Cropley, 2006). Hence, while there are still elements related to familiar knowledge, such as forming logical combinations, an aspect of convergent thinking, the emphasis shifts towards the ability to think divergently.

Lastly, the fourth form of creative cognition is described as genesis or abstraction. It concerns the creation of new information and knowledge that is significantly different from any existing information and knowledge (Lassig, 2013). In contrast to combination /synthesis that entails merging two or more existing concepts, abstraction/genesis does not allow to identify clear underlying sources that have been merged (Lassig, 2013). This form of creative cognition may result from observations leading to discoveries that have not been known or observed before (Welling, 2007). Hence, discovery is emphasized, including the exploration of novel information, and is thus strongly connected to divergent thinking processes. Yet, Welling (2007) states that even this new abstract knowledge is built on top of existing knowledge. Therefore, there are thinking processes involved that connect the newly discovered information with existing information, indicating the presence of convergent thinking processes.

In summary, a dimension differentiating the four forms of creative cognition is the emphasis on divergent or convergent thinking processes. Although each form of creative cognition entails both, a dominance of one thinking process can be inferred from literature. A related second dimension differentiating the four forms concerns the degree of novelty related to the information or knowledge being processed. In comparison, application or adaptation requires less novel information or knowledge, whereas abstraction or genesis are particularly concerned with information and knowledge significantly different from existing information and knowledge. This understanding in fact relates to what Kirton (1976) labels cognitive styles. The underlying observation to separate different cognitive styles is 'that people characteristically produce qualitatively different solutions to seemingly similar problems' (Kirton, 1976, p. 622). Hence, his observation translates to individuals engaging in separate ways of thinking when facing a given problem. In line with the four forms suggested in this study, Kirton's (1976) adaptation-innovation theory posits that there is a continuum of cognitive styles, with adaptation on the one end, describing forms of creative cognition remaining with familiar knowledge and seeking solutions based on existing experiences. The innovator's approach, located at the other end of the continuum, is characterized through unconventional thinking and viewing tasks from unsuspected angles. The four forms of creative cognition presented above can be positioned along this continuum. Importantly, a given form of creative cognition is not bound to a predefined set of thinking processes. There is even variance within the forms with respect to what extent individuals remain with familiar knowledge and to what extent novel and unusual information is processed. The suggested four forms of creative cognition thus serve to provide a tendency

where to position them along the continuum, yet there may be overlaps concerning the degree of novel information being processed. These considerations, including the degree of novelty being processed and the dominance of divergent or convergent thinking processes, are illustrated in Figure 2.

The degree of novelty in Figure 2 indicates that the forms of creative cognitions are subject to different types of information and knowledge, and ultimately ideas, that are generated, which can vary concerning their degree of novelty. It does not mean, however, that only certain forms of creative cognition result in more novel ideas. Instead, the likelihood for highly creative ideas—in terms of high originality—may change according to the degree of novelty of information or knowledge being processed and also forms of creative

cognition subject to lower degrees of novel information and knowledge bear potential for highly creative outcomes.

3 | CREATIVE COGNITION FRAMEWORK

Creative thinking, including the presented forms of creative cognition, does not happen in isolation. Positioning the considerations outlined above in extant creativity theory, creativity is subject to multiple components that directly impact creative thinking processes, as illustrated in Figure 3. In the componential model of creativity, Amabile and Pratt (2016) disentangle creativity into distinct stages. Contrasting to their approach, this work zooms in into the

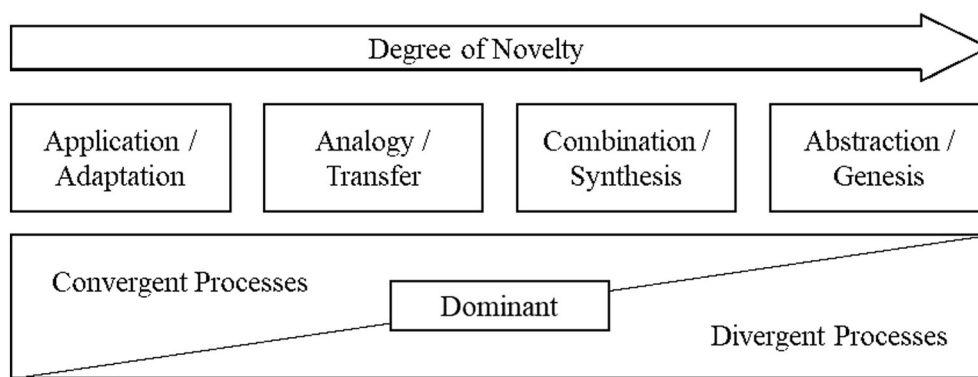


FIGURE 2 Degree of novelty associated with different forms of creative cognition

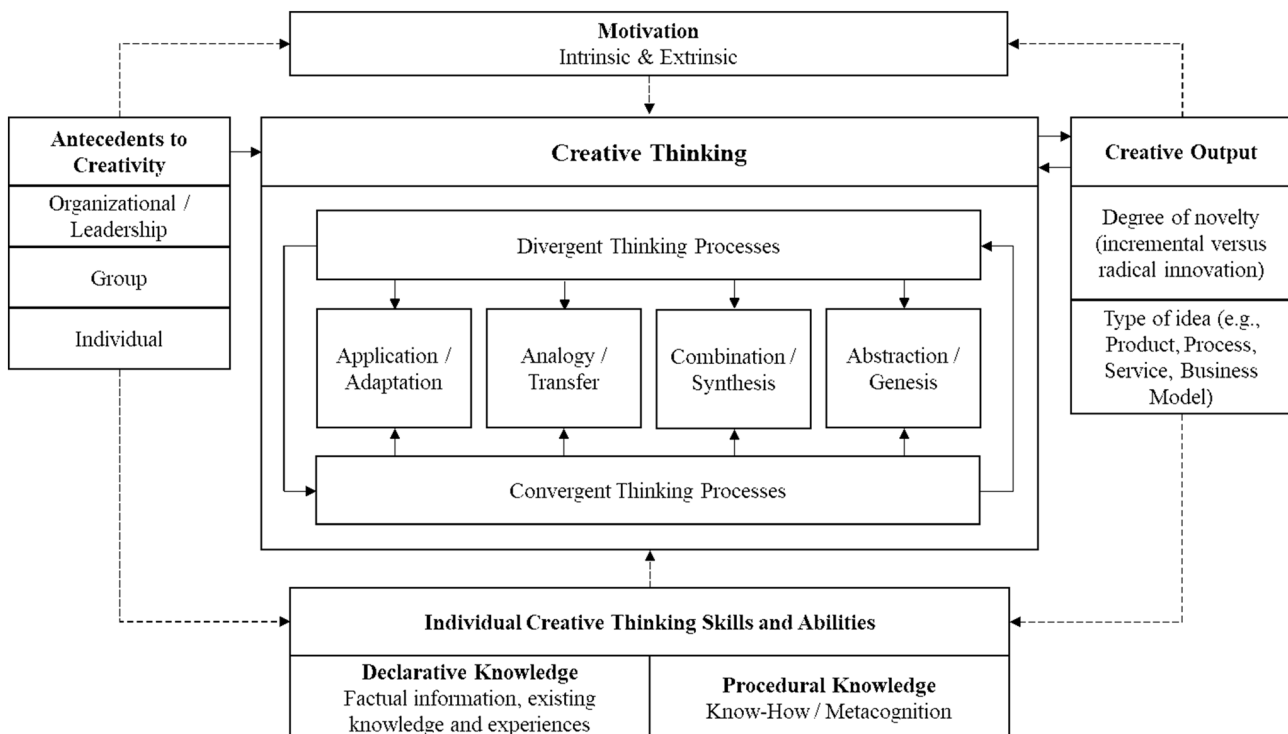


FIGURE 3 Creative cognition framework. Note: Solid lines indicate direct links between antecedents to creativity or creative output and creative thinking, whereas dashed lines indicate indirect links.

underlying cognitive processes that can occur in any creative phase, such as preparation, idea generation or idea validation. We can well imagine that, for instance, a problem can be discovered through an analogy in a related industry facing a comparable problem. Initial information for the stage of understanding the problem can spill-over from the analogy, and further necessary information can be acquired by combining knowledge from two or more past solutions. Generating ideas and solutions can then take place by slightly modifying already existing potential solutions, and further alternatives can be generated through combination, abstraction or both. Ultimately, any form of creative cognition can serve as a means to achieve the intended outcome of a given creative stage.

Following Amabile and Pratt's (2016) seminal componential model of creativity, it is the joint impact of motivation, skills and expertise that primarily shape creativity on the individual level, whereby further factors embedded in the work environment are antecedents to creative thinking. Concerning antecedents to creativity, motivational factors, including both intrinsic and extrinsic motivation, relate to the intention to engage in certain forms of creative cognition. Hence, although motivation is essential for engaging in creative thinking, it is outside the scope of creative cognition itself, as it primarily determines the willingness to engage in creative thinking. From a cognitive perspective, Amabile and Pratt (2016) resemble two types of knowledge that have been described as central determinants of cognition by Runco and Chand (1995). Individual skills are described as factual knowledge or one's expertise (Amabile & Pratt, 2016), relating to declarative knowledge (Runco & Chand, 1995). On the other hand, Amabile and Pratt (2016) describe 'creativity-relevant processes' in terms of thinking skills that can be related to procedural knowledge, which is know-how or the knowledge *how* to engage in creative thinking, in other words procedural or metacognitive knowledge (Runco & Chand, 1995).

To better understand cognitive elements of creative thinking, it is necessary to relate these two types of knowledge to creativity, as both are central in determining one's individual skills for creative thinking and are in most cases inevitably a part of creative cognition. There may be exceptions with individuals having brilliant creative ideas without particular relevant knowledge (as argued by Cropley (2006), relating to 'lucky hits'). But in a normal course of events, engaging in creative thinking requires certain knowledge—following the lines that the exception proves the rule. Hence, as argued above, any form of creative cognition is subject to both divergent and convergent thinking processes, and both thinking processes are shaped by declarative and procedural knowledge. Only the joint consideration of creative cognition and the underlying required knowledge that enables creativity provides a cohesive understanding on cognition and creativity. As the primary focus of this theoretical work is a cognitive perspective on creative thinking, the emphasis in the following sections will be on the knowledge elements related to creativity. Subsequently, literature is reviewed and synthesized with respect to the relationship between antecedents to creativity and cognitive elements of creativity and how intended creative outcomes shape the engagement in creative cognition.

3.1 | Individual creative thinking skills and abilities

3.1.1 | Declarative knowledge

Declarative knowledge represents an individual's factual information and knowledge gained through previous experiences (Runco & Chand, 1995). This type of knowledge is hence closely connected to episodic memory, describing the ability to recollect specific personal experiences (Madore et al., 2015). There is ample evidence for a positive relationship between declarative knowledge and creativity. For instance, individuals may use existing knowledge to assess similarities between past experiences and a potential identified opportunity or problem. Past experiences thereby support determining whether the discovered opportunity or problem is recognized as such and needs to be addressed (Cowan, 1986). Having experience and being familiar with the task domain subsequently reduces uncertainty towards a task to be solved (Cowan, 1986). Exploration of existing domain knowledge can hence constitute a facilitative factor for problem-solving (Runco & Dow, 1999) and the generation of original ideas (Rietzschel et al., 2007) and having knowledge across different domains further benefits ideation performance (Björk, 2012). This domain-spanning knowledge can also be linked to the analogy/transfer form of creative cognition, as analogies are more frequently drawn between knowledge domains matching an individual's knowledge background (Christensen & Ball, 2016). Beyond ideation, declarative knowledge also contributes to the evaluation of generated ideas. Grohman et al. (2006) find that individuals who are more proficient in divergent thinking, hence having gained experience, are more proficient in evaluating the uniqueness of their own ideas.

The importance of declarative knowledge further becomes evident by considering not only the beneficial effects but also the effects of a lack of declarative knowledge. Creative ideas are, by nature, subject to novel and unfamiliar information, which are associated with ambiguous risk. Risk averse individuals tend to reject ideas that imply undue risk (Mumford et al., 2006), which might be due to a lack of knowledge to adequately assess the risk associated with an idea. This may be particularly relevant for highly novel ideas, such that these ideas are ultimately prematurely excluded from further consideration. Mueller et al. (2012) provide a further explanation and find in an experimental study that even the mere perception of uncertainty is negatively related to the recognition of creative ideas. Thus, having sufficient experience in evaluating the risks associated with an idea decreases the risk of premature rejection of potentially creative ideas.

Furthermore, individuals require knowledge and experiences in order to separate relevant and irrelevant information (Gielnik, 2010). A lack of knowledge can thus lead to the identification of irrelevant information, resulting in an attempt to draw connections and form associations when no connections can, or should, be made. The importance of declarative knowledge in the context of identifying appropriate information can be expected to increase for forms of creative cognition requiring the processing of more novel information, as illustrated in Figure 2. Moreover, existing knowledge is essential not only to identify relevant information but also to match and connect

both. For example, Baron (2006) states that pattern recognition, the ability to recognize links between complex and seemingly unrelated events, facilitates the identification of business opportunities. Also referred to as 'connecting the dots' (Baron, 2006), forming these associations benefits from access to a diverse set of information (Gielnik et al., 2012) and is further supported by a proactive search for information (Baron, 2007; Ucbasaran et al., 2008). From a cognitive perspective, recognizing such patterns thus requires prior knowledge, for instance, in a certain industry or market (Baron, 2006, 2007). Using this knowledge, individuals form cognitive frameworks to identify opportunities. For instance, by referring to concrete previous experiences, links between seemingly unrelated events can be recognized, which contributes to the alertness of individuals to actually perceive new opportunities (Baron, 2006; Gaglio & Katz, 2001). Reversing this line of argument, little knowledge thereby may lead to individuals remaining with the limited, rather familiar knowledge. A lack of knowledge would thus imply that specific dots may not be recognized, resulting in an incomplete, or not even identified, opportunity or that some connections between the dots cannot be made. Hence, although there might be an opportunity, individuals do not recognize it as such and prefer to maintain the status quo (Gaglio & Katz, 2001).

Thus, one's existing knowledge and past experiences with an organization, market, technology or industry can positively contribute to the fundamental aspects of creative thinking, including problem discovery and description, idea generation and idea evaluation. As outlined in the previous section, all forms of creative cognition include thinking processes related to existing, and thus, declarative knowledge, but to varying degrees. There is, however, little research specifically disentangling the degree to which declarative knowledge is useful to the distinct forms. We do not know how individuals may, for instance, identify business opportunities. Using Baron's (2006) example of pattern recognition, forming remote associations can help to enhance an already exploited opportunity through adaptation, to recognize a potential analogy between the connected domains or to merge the distinct pieces of information into something new. Hence, without specifically examining the particular form of creative cognition that is used for pattern recognition, there is no evidence to what extent declarative knowledge may affect individual forms. All forms can be equally suitable to ultimately identify business opportunities—or, considered on a more abstract level, to produce creative ideas.

Although it was shown that declarative knowledge is essential for creative thinking, it can also be inhibitive. High levels of existing domain knowledge can bias individuals with respect to creative problem solving, as it can result in overconfidence (Baron, 1998), and narrows the search for appropriate solutions to the existing knowledge base and thus inhibits a broader search for novel information, resulting in fixation (Wiley, 1998). Having too much knowledge can lead to the perception that one knows everything and hence become intolerant to change (Sternberg, 2005). However, creativity is about change. Someone believing to know everything will reject ideas merely based on the belief in their knowledge and without conducting further research (Sternberg, 2005). As a result, familiar knowledge is overemphasized, and the exploration of novel information is hampered. This

overemphasis should be less relevant to forms of creative cognition that do not require a large share of novel information. However, with increasing novelty being processed, the tendency to reject change or to not engage in divergent thinking processes to search for novelty can be detrimental to creative thinking.

3.1.2 | Procedural knowledge

Procedural knowledge refers to metacognitive knowledge or the knowledge *how* to engage in creative thinking (Runco & Chand, 1995). Metacognition describes the thinking about thinking, being aware of one's awareness, knowing how one best remembers knowledge and awareness when to use certain cognitive strategies (Livingston, 2003). This may, for instance, simply be the knowledge that one has to proactively search for information (Ucbasaran et al., 2008) or to identify and acquire 'knowledge, skills, and specific information necessary to tackle [a] problem' or opportunity (Amabile & Pratt, 2016, p. 163). Metacognitive knowledge also refers to awareness, such as being aware that conceptualizing an already identified problem from new angles requires to think outside the box and to deliberately search for unusual additions to a problem at hand, which can pave the way for breakthrough ideas (Basadur, Pringle, et al., 2000). Gabora (2002) further states that forming intuitive associations intending to reveal remote or subtle connections can benefit creative thinking; hence, it requires the knowledge that one may utilize intuition. In the context of idea evaluation, a combination of intuitive followed by rational thinking has been found to positively contribute to idea evaluation quality and speed (Eling et al., 2015), which Zhu et al. (2017) validate in a study confirming the positive effect of intuitive thinking on creative idea selection. While rational thinking refers to convergent thinking processes, intuitive thinking is rather associated with divergent thinking processes (Razoumnikova, 2013). Hence, although the exemplary studies outlined above concern one particular goal, idea selection, abstracting these findings to divergent and convergent thinking processes emphasizes a relationship to the four forms of creative cognition. In general, procedural knowledge is reflected in the awareness of relationships between factors influencing creativity and how to utilize these factors. It is thus knowledge concerning positive or negative effects of specific influencing factors and how to adequately use this very knowledge in the context of creativity. This metacognitive awareness facilitates processing and transforming information with the goal to generate creative ideas (Feldhusen, 1995).

In contrast to facilitative aspects of procedural knowledge for creative thinking, a large share of literature is dedicated to inhibitive aspects. These inhibitive aspects relate to mistakes occurring during creative thinking and primarily refer to cognitive biases. It is essentially a lack of procedural knowledge or the unconscious application of inappropriate procedural knowledge that results in the occurrence of cognitive biases. Such procedural mistakes are well-documented. A detailed review on over 30 cognitive biases is provided by Mumford et al. (2006). Fundamentally, any cognitive bias identified in their review can be associated with a lack or inappropriate application of

procedural knowledge. In the following, cognitive biases that are regularly addressed in the intersection of management, creativity and cognitive psychology literature are exemplarily presented and related to the suggested creative cognition framework. Particularly important to creativity are procedural mistakes that interfere with the search for novel information, and hence relate to all four forms of creative cognition. Yet, with an increasing amount of novel information being processed, cognitive biases that interfere with identifying and processing this novel information become increasingly severe.

The tendency to prefer information that can be acquired at low cost and which is readily available (Mumford et al., 2006), for instance, hampers the identification of rather unusual or distant information. This tendency can be further invigorated through additional biases, such as the confirmation bias. The confirmation bias refers to the tendency that individuals prefer to seek, recall or interpret information that validates their beliefs, rather than invalidating them (Hallihan & Shu, 2013; Nickerson, 1998). Mumford et al. (2006) further find three biases particularly relevant for creative thinking. First, the representative bias, which relates to the tendency to recall information that is known and familiar, inhibits the search for novel information and thus stifles production of more original ideas; second, illusory correlation, describing the process of applying a complete set of associated features of familiar knowledge³ to new knowledge, although only one or few features might in reality be applicable to the new knowledge; and third, the anchoring bias, relating to the fixation on initially developed ideas resulting in a neglect of potential alternatives.

A common consequence of the above-mentioned cognitive biases is the preference for familiar rather than for novel information. In fact, individuals tend to judge familiar ideas more favourably, although more creative ideas are, by nature, often those that individuals are less familiar with (Rietzschel et al., 2010). This can lead to the rejection of more original ideas when preferring the known over the novel. This may particularly be the case if individuals have to evaluate various ideas, among which there are ideas that individuals generated on their own and thus perceive ownership (Onarheim & Christensen, 2012). Individuals tend to overweight their own ideas, while underweighting ideas of others (Keum & See, 2017). This cognitive notion links to prominent barrier within the innovation management literature. Ideas from external sources are often confronted with negative attitudes, which is described through the not-invented-here (NIH) syndrome (Antons & Piller, 2015; Katz & Allen, 1982). The NIH syndrome can even occur when all individuals who suggest ideas belong to the same organization, or organizational unit, and is not limited to ideas outside of organizational boundaries (Antons & Piller, 2015). Individuals may reject external ideas and information because they apply decision heuristics, such as processing only selected information, or being subject to the above-mentioned confirmation bias (Antons & Piller, 2015). The NIH syndrome can thus be considered a cognitive bias concerning the perception and judgement of information.

Cognitive biases resulting in preference for familiar information can further lead to premature decisions, resulting in a nonexhaustive search for relevant information once the existing beliefs about the understanding of an initial thought are sufficiently confirmed. Making

premature judgements on initial thoughts stifle an appropriate conceptualization and thus lead to premature conclusions (Basadur, Pringle, et al., 2000). This process can be more generally described as premature convergence that can also be stimulated by the urge of individuals to judge and analyse generated ideas immediately (Basadur et al., 1990) and thus can hamper the process of generating further alternatives. This can, for instance, result in a dilution of goals, as ideas are already evaluated although the phase of generating ideas has not yet ended (Basadur & Finkbeiner, 1985; Basadur, Runco, & Vega, 2000).

Besides the link between cognitive biases and identification of novel information, there is also evidence on inappropriate procedural knowledge on how to explore one's existing domain knowledge. Literature on innovation initiatives highlights the local search bias as a barrier to innovation and hence to creativity as underlying process (Rosenkopf & Almeida, 2003). On the one hand, locally searching for information and knowledge, and balancing local and distant knowledge, can have a positive effect on subsequent exploration phases (Suzuki & Methé, 2014). On the other hand, overly relying on information and knowledge that are within the boundaries of an organization is considered a traditional factor that hampers the generation of novel ideas (Poetz & Prügl, 2010). Hence, individuals must be aware and develop a sense for assessing to what extent existing declarative knowledge should be explored and how to balance familiar and novel information and knowledge when engaging in creative thinking.

Concluding, procedural knowledge dictates the strategy on how to engage in creative thinking (Runco & Chand, 1995). As shown above, if the chosen strategy is affected by cognitive biases, it can severely reduce an individual's ability to generate creative ideas. Cognitive biases resulting in neglect of novel information are particularly detrimental to creative cognition as a larger share of novel information being processed is required. Furthermore, inappropriate application of procedural knowledge to identify suitable existing knowledge can equally be detrimental to engaging in creative thinking. The key is being aware of certain strategies that can boost creative performance and being aware of common pitfalls induced by cognitive biases. As an example, Lu et al. (2017) find that alternating between creative tasks dominated by either divergent or convergent thinking reduces cognitive fixation and individuals who alternate outperform individuals who engage in creative tasks sequentially. Alternation is thus a strategy to mitigate potential downsides of cognitive fixation. However, individuals must be aware of that strategy to actively counteract and must have the individual ability to engage in this coping strategy—or in other words, they must have appropriate procedural knowledge.

3.2 | Antecedents to creative thinking

3.2.1 | Motivation

Motivation to engage in creative thinking is depicted distinct from antecedents to creativity in the framework, yet it is a fundamental

precursor to creativity. The underlying reason to depict it externally to other antecedents in Figure 3 is the consideration that any antecedent is less effective, or even ineffective, in stimulating creativity if individuals are not motivated to engage in creative thinking in the first place. A lack of motivation can lead individuals to use heuristics, which are strategies derived from previous experiences in order to make best guesses (Runco & Chand, 1995), which results in not thoroughly engaging in creative thinking. Using heuristics may save time, but they are also linked to cognitive biases as described above (Runco & Chand, 1995), and hence, a lack of motivation connects to inappropriate use of procedural knowledge.

In the dynamic componential model of creativity (Amabile & Pratt, 2016), the two primary motivational aspects relevant to creativity relate to intrinsic and synergistic extrinsic motivation. Intrinsic motivation has been shown in numerous studies to be positively related to creativity (Cerasoli et al., 2014; Fischer et al., 2019). Extrinsic motivation is primarily relevant if there are synergies to intrinsic motivation (Amabile & Pratt, 2016). If extrinsic motivation is not linked to intrinsic motivation, it may be perceived as controlling behaviour from leaders or the company (Amabile & Pratt, 2016), which can result in decreased motivation. Extrinsic rewards can be tangible, such as monetary rewards or intangible, such as being praised or receiving recognition and feedback (Fischer et al., 2019). There is, in fact, a long-standing debate on whether primarily intrinsic motivation stimulates the engagement in creative thinking, whether extrinsic motivation erodes intrinsic motivation (Cerasoli et al., 2014; Eisenberger & Shanock, 2003) or whether only certain types of extrinsic motivation are important for creativity (Fischer et al., 2019). A comprehensive meta-analysis suggests that intrinsic and extrinsic motivation should not be considered antagonistic, but their joint and simultaneous impact best explains individual performance (Cerasoli et al., 2014).

Yet, beyond the evidence regarding a lack of motivation that can be linked to procedural knowledge, there is surprisingly little explicit empirical evidence on a direct relationship between motivational factors and cognitive elements of creativity. To better understand the motivation–creativity relationship, it is not only necessary to research whether there are positive or negative effects but also to understand the mechanisms in creative thinking that are impacted by motivational factors. Evidence on how motivation relates to cognitive processes could in fact provide explanations as to why extant research has produced ambiguous results. Nonetheless, there is some evidence for this relationship. Bergendahl et al. (2015) find that intrinsic motivation is particularly important for knowledge intensive activities. Complementarily, Teigland and Wasko (2009) argue that intrinsic motivation can be founded in the goal of improving one's own competences, which contributes to the engagement in creatively solving challenging tasks. Intrinsic motivation may therefore stimulate the exploration of knowledge and the use of a form of creative cognition that requires processing more complex and novel information and knowledge.

A second link between motivation and creative cognition can be inferred from the individual expectancy towards receiving rewards as

motivational factor related to individual creative performance. As suggested through the four forms of creative cognition, individuals may engage in distinct cognitive processes to achieve similar goals. The individual perception of one's performance may depend on how the goal was achieved, that is, which form of creative cognition has been adopted. One may expect less rewards when an idea has been generated through modification of an existing idea but expect higher rewards when an idea has been generated through genesis. The resulting idea might be the very same—but the approach, and hence the perceived individual effort to achieve the goal, can differ and accordingly also the expectation towards being rewarded. Thus, expected rewards must match the perceived effort required to offer sufficient motivation to engage in individual forms of creative cognition. Literature provides evidence to support this claim. The expectation of individuals that performance is accordingly rewarded has been found to increase intrinsic motivation and to be directly positively related to creativity (Eisenberger & Aselage, 2009; Eisenberger & Rhoades, 2001). Although the line of argument provided above can be supported by literature, this direction requires further research to disentangle the effect of reward expectancy on motivation. In particular, how the reward–expectancy relationship relates to the individual choice or adoption of forms of creative cognition contingent on perceived effort has not yet been addressed thoroughly in literature.

3.2.2 | Antecedents to creativity on the organizational- and leadership-level

Antecedents on the organizational- and leadership-level are, from a cognitive perspective on creativity, responsible for providing necessary resources to acquire information and knowledge (Amabile & Pratt, 2016; Reiter-Palmon & Illies, 2004) and to stimulate suitable forms of creative thinking. Having access to sufficient resources stimulates creativity (Amabile & Pratt, 2016), and likewise, organizational culture promoting an innovative climate and a safe environment can positively contribute to creativity (Anderson et al., 2014). For instance, Basadur and Hausdorf (1996) encourage organizations to establish a culture wherein new ideas are valued and employees do not feel too busy to deal with new ideas, which then positively contributes to the willingness to engage in divergent thinking. Hence, it is more likely that employees do engage not only in forms of creative cognition that are closely related to familiar knowledge and convergent thinking processes that may be associated with lower risk but also in creative thinking requiring a higher degree of divergent thinking processes. On the opposite side of valuing new ideas is fearing consequences of generating new ideas. Groth and Peters (1999) list a broad variety of factors inhibiting creativity, whereby fear-related issues, such as fear of failure or fear of rejection, are repeatedly mentioned and are identified as the most prominent inhibitors for creativity. If employees perceive fear because of the organizational culture, they may reject engaging in cognitive processes that imply undue risk, which is typically the case when a high degree of novelty is part of a creative thinking process.

Leaders can actively contribute to creating an environment that appraises novelty and reduces fear. Fundamentally, it is a decision of employees whether to explore novel information during creative thinking or whether to remain with familiar knowledge. According to regulatory theory, a decision process under promotion focus emphasizes positive aspects and gains, whereas a prevention focus emphasizes low risk and avoidance of losses (Higgins, 1997). The findings from de Buissonjé et al. (2017), for example, show that a promotion focus benefits the selection of creative ideas. Thus, leaders communicating a promotion focus actively contribute to appraisal and acceptance of novelty. This grants employees a safe environment to engage in a form of creative cognition that is deemed suitable, independent of the share of novel information being processed.

3.2.3 | Antecedents to creativity on the group-level

It is important to acknowledge that cognition happens in the minds of individuals, and can, by nature, not constitute a group-level process. Although individual and group creativity play a central role in creativity research (Anderson et al., 2014), ultimately, however, creative ideas originate from individual thoughts, or individual insight, that are only subsequently further processed through collective interaction (Hargadon & Bechky, 2006). Group creativity is thereby a function of individual creativity (Woodman et al., 1993). Group dynamics, characteristics, and composition certainly have a strong impact on creativity (Goncalo & Staw, 2006; McGlynn et al., 2004; Nijstad & Stroebe, 2006), and thus, group creativity is more than a simple aggregation of individual creativity (Woodman et al., 1993). Group dynamics ultimately impact and shape how individuals engage in creative cognition. The central fundament of creativity, the processes occurring within the forms of creative cognition that lead to the emergence of creative ideas, however, exclusively occurs on an individual level, in the minds of single individuals. It is thus crucial to understand how group interactions and compositions relate to the individual.

Groups essentially broaden the breadth and variety of available knowledge, both domain and procedural, required to engage in creative thinking. Working creatively in groups can stimulate the exploration of existing domain knowledge if individuals are exposed to ideas of fellow group members, yielding beneficial effects on generating more original and more high-quality ideas (Paulus & Brown, 2007; Rietzschel et al., 2007). Sharing and communicating the results of individual creative thinking processes within a group thereby facilitate the formulation of relationships between single thoughts. As Caniëls et al. (2014, p. 104) find, 'by making ideas explicit to others, divergent thoughts are crafted into coherent concepts.' These two perspectives indicate two links to creative thinking—an indirect link through stimulating the exploration of one's existing knowledge and a direct link to creative thinking through support in matching individual thoughts occurring in creative thinking processes to coherent ideas. Furthermore, a social perspective on groups further provides evidence on a link between group-level antecedents and motivational factors as antecedents to creativity. Individuals high in prosocial motivation,

indicating a concern of an individual within a group to achieve joint outcomes and joint success, are more likely to pool available information and engage in collaboration (de Dreu et al., 2008). Hence, social factors can impact task motivation, which in turn impacts creative thinking (Paulus & Brown, 2007).

Therefore, sharing of declarative knowledge offers a broader knowledge basis for all group members to draw on, and they can help each other avoiding cognitive biases through sharing procedural knowledge. Yet, there are limitations to group effects on creativity. Groups require time to get familiar with each other; newly formed and diverse groups may in fact perform worse in creative tasks than diverse groups that know each other for a longer time, partially due to differences in knowledge sharing behaviours (Zhang, 2016). In a comprehensive literature review, Anderson et al. (2014) report mixed findings on group creativity. Task and goal interdependencies, team climate or heterogeneity and team diversity have been found impact creative performance but are subject to ambiguous research results (Anderson et al., 2014). To explain this ambiguity, it could in fact help to better understand how groups coordinate creative thinking. There may well be differences if diverse groups also engage in diverse forms of creative cognition, according to individuals' strengths and experiences or whether diverse groups push to engage in specific cognitive processes, thereby cutting out creative potential. The ambiguity in research on group creativity could be to some extent explained through more fine-grained research taking into account cognitive aspects of creativity. Groups may not only have diverse knowledge but also have diverse cognitive experiences and thus approaches to creativity. Recent research increasingly adopts cognitive differences of group creativity in diverse groups, such as differentiating divergent and convergent thinking processes (Coursey et al., 2019; Coursey et al., 2020; Yuan & Zhou, 2015), yet there is ample and promising room for further research to follow this direction. In particular, how groups coordinate on how to engage in creative thinking, that is, the adoption of distinct forms of creative cognition, could deliver important insights to group creativity. Whether groups adopt similar or more diverse forms of creative cognition, and how this relates to group creative performance, is a dimension of group heterogeneity that has not been thoroughly addressed in creativity research.

3.2.4 | Antecedents to creativity on the individual-level

A conditional factor to utilize any type of knowledge is the cognitive capacity of an individual that determines the amount of information that can be processed (Elsbach & Hargadon, 2006; Hallowell, 2005). de Dreu et al. (2012) similarly relate the capacity to conduct cognitive processes to working memory capacity. Individuals with high cognitive capacity are able to maintain the focal point of attention on the task at hand and to avoid mind wandering (de Dreu et al., 2012). When individuals are overloaded with information, their brains start working in 'survival mode', which can result in impatience and thus in impulsive judgements to finish whatever matter is at hand

(Hallowell, 2005). Exceeding one's cognitive capacity can be a consequence of an intensive search for information. However, it can also originate from information sharing in groups, which can invigorate the risk of group members becoming overloaded with information (Paulus, 2000). Hence, one's cognitive capacity is a superordinate factor to process information and knowledge in the context of creative thinking. Although the concepts of cognitive capacity, or cognitive load, are well-known in literature (DeLeeuw & Mayer, 2008; Ouwehand et al., 2021), recent studies point out that it still tends to be overlooked in the context of creativity research (Redifer et al., 2019; Redifer et al., 2021). From a cognitive perspective, overlooking cognitive capacity is critical, as individuals manage capacity limitations through simplification strategies that limit the search for new information (Mumford et al., 2006). These simplification strategies, however, are a potential source for cognitive biases to occur in creative thinking (Mumford et al., 2006) and hence can be highly detrimental to creativity.

It must be acknowledged that divergent and convergent thinking themselves are considered cognitive abilities (Cromptley, 1999; Palmiero et al., 2020; Weiss et al., 2020). Individuals cannot simply decide to engage in the respective cognitive processes on a proficient level. As such, the cognitive processes elaborated in this conceptual work largely depend on the individual ability and skill to engage in these thinking processes. As individuals may have better abilities in either divergent or convergent thinking (Brophy, 2001; Cromptley, 2006), the effective engagement in the underlying cognitive processes is contingent on the individual ability to perform divergent or convergent thinking. Thus, a tendency of individuals to adopt forms of creative cognition matching their individual skills and experiences can be assumed.

Factors on the individual level impacting cognitive elements to creativity are abundant in extant literature. For instance, specific individual personality traits (Caniëls et al., 2014), such as differences in the Big Five personality traits, benefit either divergent or convergent thinking (Myszkowski et al., 2015). While divergent processes can benefit from openness to experience and suffer from agreeableness, convergent processes can benefit from agreeableness. In this context, Diedrich et al. (2018) find that such personality traits predict real-life creativity even better than indicators of skills in divergent thinking. This provides an indication that individuals may tend to adopt forms of creative cognition matching their personality traits, such as consciously engaging in forms of creative cognition that tend to be dominated by either divergent or convergent thinking processes.

A further individual factor determining engagement in creative cognition is affective states, including moods and emotions (Amabile et al., 2005; Anderson et al., 2014; Baas et al., 2008). Positive affect, such as happiness or joy, can broaden the ability to make unusual associations and as such be beneficial for divergent processes (Isen & Daubman, 1984). In contrast, negative affect, such as sadness or anger, stimulates more analytical and detail-oriented information processing (Martin et al., 1993; Schwarz, 1990) and thus can be beneficial for convergent processes. An individual's current affective state can thus influence creative performance contingent on which form of

creative cognition has been chosen, as affect can facilitate divergent or convergent thinking processes. An individual's current affective state may thus equally impact the engagement in different forms of creative cognition. While there is empirical evidence on the relationship between affective states and divergent or convergent thinking (Baas et al., 2008), there is very limited evidence taking into account the impact of affect on forms of creative cognition.

3.3 | Creative output

3.3.1 | Degree of novelty

For organizations, creativity is a central part of innovation. Similar to creativity, innovation is considered an information processing activity (Kleinschmidt et al., 2010). Differentiating innovations along the degree of innovativeness may require diverse types of knowledge being processed. Hence, the projected goal of creative thinking also directly influences individual engagement in creative cognitive processes. For instance, connected to the concept of ambidexterity, incremental innovation is subject to exploitation activities related to existing products, while radical innovation is subject to exploration activities related to identifying new opportunities and the development of new knowledge (Andriopoulos & Lewis, 2009). The relation to information processing in the context of incremental and radical innovation is thus related to processing familiar and existing knowledge or seeking and identifying new knowledge, respectively. Thereby, this separation reflects the defined characteristics of convergent and divergent thinking processes and the degree of novelty being processed. Accordingly, creative processes that can ultimately result in more incremental or more radical innovations may thus be subject to different requirements concerning the underlying forms of creative cognition.

Coupling creative endeavours pursuing highly innovative outcomes with individual personality traits leads to a further connection between creative outcomes and motivation. Individuals can be motivated to engage in creative thinking through a need for uniqueness (Dollinger, 2003) and need for cognition (Dollinger, 2003; Watts et al., 2017; Wu et al., 2014), describing a perceived urge to create unique ideas and to engage in abstract and novel ways of thinking, respectively. Thus, for individuals with high needs for uniqueness and cognition, an intended outcome of creativity that is subject to high novelty influences motivation to engage in creative thinking. Motivation, as described above, is then linked to cognitive elements of creative thinking, forming an indirect link between creative outcomes and creative thinking processes through motivational factors.

3.3.2 | Type of creative idea

Furthermore, distinct types of innovation require different knowledge for idea generation and assessment criteria to evaluate novelty and usefulness. For instance, the degree of innovativeness of physical

products can be measured along dimensions such as technical or design newness (Talke et al., 2009), whereas business model innovation can be measured in terms of how many components of a business model have been altered (Clauss, 2017). Extant literature further highlights differences in the effect of innovation processes on innovation performance, contingent on the separation into service- or product-based firms (Schultz et al., 2019). As creative thinking is an implicit function of the innovation processes, this finding points out a potential effect of creative processes on innovation performance dependent on the type of innovation. Thus, individuals require different knowledge and process information differently contingent on the targeted type of innovation, and as such, creative cognitive processes are affected through a link between intended creative outcomes and required declarative and procedural knowledge.

4 | DISCUSSION

The overarching goal of this work was to offer an integration of concepts related to creative thinking processes, contributing to support a multidisciplinary perspective on creativity. Extant literature is subject to conceptual ambiguity that originates from deviating understandings of divergent and convergent thinking processes in combination with a tendency to overemphasize creative outcomes and to neglect how individuals eventually engage in creative thinking processes (Fortwengel et al., 2017; Sonenshein, 2016). It is argued that divergent and convergent thinking processes are not iterative nor exclusive to distinct stages of creativity but occur concurrently (Goldschmidt, 2016). More specifically, rather than engaging in divergent or convergent thinking, individuals utilize superordinate forms of creative cognition to engage in creative thinking. Often overlooked,

these forms of creative cognition are positioned as a connecting layer between creative thinking processes and the prevalent stages of creativity in organizational research.

Previous literature reviews on creativity tend to offer a similar picture in that empirical evidence on factors influencing creativity delivers mixed and ambiguous results, including positive, negative or nonsignificant findings for the very same factors (Acar et al., 2019; Anderson et al., 2014). It is suggested that one source for this ambiguity is the complex and multifaceted nature of creativity, resulting in a diluted and blurred understanding of theoretical concepts underlying creativity. This complexity is also reflected in that creativity research is multidisciplinary, and in order to create a more comprehensive understanding on creativity, it is necessary for future research to increasingly integrate a multidisciplinary perspective. The elaborated creative cognition framework in this paper offers one route for this purpose.

More specifically, this theoretical work offers two central contributions. First, in developing the framework, a clarification and differentiation of creativity concepts are presented and disentangled. This intends to support future research in choosing and using different concepts appropriately. Second, the more novel contribution of this work relates to the identified relationships among antecedents to creativity, knowledge components relevant to creativity, creative thinking itself and creative outcomes, as indicated in Figure 4. Although cognitive concepts of creativity are increasingly adopted in organizational research, the linkages of cognitive processes to creative outcomes tends to be blurry and often not well-understood. This work seeks to offer guidance by integrating the concept of creative cognition into the relationship between stage models of creativity and divergent and convergent thinking, constituting the most widespread concepts in organizational research on creativity. As these central concepts have

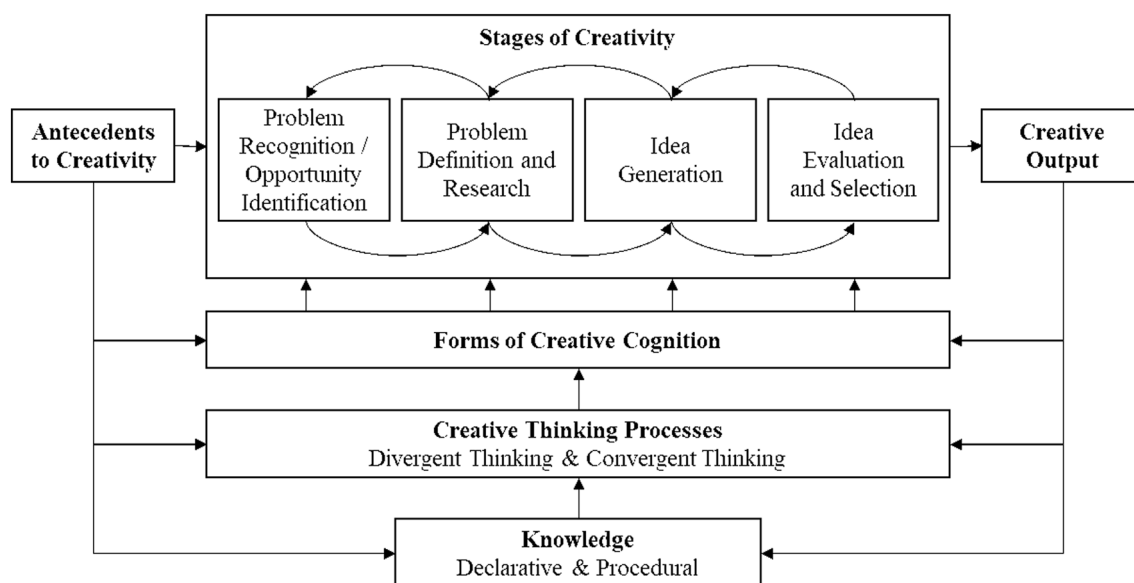


FIGURE 4 Relationship between cognitive elements of creativity (knowledge, creative thinking processes and forms of creative cognition) and stages of creativity

been mostly assessed individually in extant literature, there is ample room for further developing creativity research through a stronger integration of these multidisciplinary concepts.

4.1 | Theoretical implications

Through reviewing and integrating literature on creativity, a connecting cognitive layer is suggested that bridges antecedents to creativity and creative outcomes. This cognitive layer consists of different forms of creative cognition that comprise both divergent and convergent thinking processes. Against this backdrop, creativity studies have been relying on well-established tests for divergent and convergent thinking abilities, such as the Alternative Uses Task, the Torrance Tests of Creative Thinking or the Remote Associates Test, for a long time as a means to assess creativity (Cortes et al., 2019). However, creativity researchers have repeatedly advocated in the past that future studies are required to move beyond these well-established tests as a sole measurement, as they are not designed to assess creativity on a more comprehensive level (Cortes et al., 2019; Cropley, 2000; Kim, 2006) but serve as indicators for creative potential (Cropley, 2000; Runco & Acar, 2012). The derived creative cognition framework intends to address this prevalent overemphasis on divergent and convergent thinking as means to assess creativity and seeks to serve as a source of inspiration for future study designs. Further research on creativity is recommended to determine the relevance of creative cognition in an organizational context. Focusing on forms of creative cognition expands the conceptual understanding and answers calls to broaden assessment tools for creativity (Zeng et al., 2011).

A further central issue identified in this work is that literature tends to neglect the individual's adoption of a particular form of creative cognition to achieve intended creative outcomes. Although previous research has identified distinct forms of creative cognition as illustrated in Figure 2 (also see Kirton, 1976; Lassig, 2013; Welling, 2007), there is a significant research gap concerning the conditions and circumstances that guide individuals to engage in one or more forms of creative cognition. Admittedly, creative cognition is complex to integrate in study designs and many studies do not consider it altogether. Although acknowledging the interplay and relevance of both divergent and convergent thinking, there is still a tendency to link divergent or convergent thinking directly to idea generation or evaluation (e.g. Berg, 2016; Puccio et al., 2020). While there certainly are relationships, the question remains whether they are directly or more indirectly linked to creative outcomes through forms of creative cognition. In fact, research has shown that individuals apply different strategies when working on similar creative tasks (Dorst & Cross, 2001; Ward, 2007), but these strategies are not yet well-understood in an organizational context. Taking into account different forms of creative cognition could offer more fine-grained results on how individuals achieve creative outcomes. It is suggested that the engagement in different strategies, or forms of creative cognition, is guided through the share of novel information being processed and whether divergent or convergent thinking processes are

dominant. In particular, factors influencing this adoption process of engaging in different forms of creative cognition could be taken into consideration both consciously and unconsciously. This may include an individual's divergent or convergent thinking abilities, previous experiences and hence acquired knowledge. More empirical evidence on these underlying factors as precursors to engagement in creative thinking could help to better explain some of the ambiguity in creativity research.

To facilitate positioning empirical findings on creativity within the creative cognition framework, three paths of how factors influence cognitive elements of creative thinking are suggested. There is a direct link, connecting antecedents and aspects of creative outcomes to forms of creative cognition. In addition, two indirect links are indicated. The first indirect link relates to knowledge components, which are inevitably linked to cognitive processes. Some identified factors do not only directly link to creativity but also affect the availability of factual information or the utilization of procedural knowledge. For instance, group-level factors can enhance the overall knowledge pool that is relevant to creativity but at the same time result in cognitive biases that lead to the application of inappropriate procedural knowledge. A second indirect link is related to stimulating motivation, as, for instance, the intended creative outcome may not only directly determine the engagement in a form of creative cognition but also offer motivation in form of the opportunity to create novel and unique ideas in conjunction with an individual's need for cognition and need for uniqueness. This distinction in separate paths is believed to be central to explain a portion of the mixed results in extant literature. Creativity studies need to be comparable with respect to the specific direct or indirect relationships being researched and clearly articulate these relationships accordingly.

4.2 | Managerial implications

When engaging in creative thinking, it is essential to be aware that creative ideas rarely just 'pop up' from nothing. Engaging in creative thinking is contingent on numerous factors—personality traits, existing domain knowledge, previous experiences that form know-how or leadership support. The key to utilize these factors to facilitate creative thinking is to be aware *how* to utilize them. Individuals make decisions, often unconsciously or in some cases consciously, relating to the form of creative cognition they engage in. It is essential to have awareness that adopting distinct forms of creative cognition can differ in terms of the dominance of divergent or convergent thinking processes or the share of novel information being processed and are subject to diverse cognitive biases. Having awareness of these relationships and knowing how to avoid cognitive biases can help building metacognitive knowledge, which in turn has been shown to facilitate creativity. Hence, the creative cognition framework offers a source for creating metacognitive knowledge for individuals who engage in creative thinking.

In this context, the framework indicates that leaders must be aware that to facilitate creativity, the means to stimulate creative

thinking should match the form of creative cognition. For instance, simultaneously encouraging divergent thinking and adaption as a form of creative cognition may be less effective compared with stimulating convergent thinking in the same context. However, it must be emphasized at this point that creative thinking is not a linear process and individuals may alter creative processes, iterate thinking processes and engage in various forms of creative cognition throughout the development of ideas. This requires constant and dynamic adaptation of measures to facilitate and support creativity and, most importantly, to not hinder creative thinking through too tight restrictions in the means how to achieve creative ideas.

Literature has already shown that balancing divergent and convergent thinking tends to be beneficial for creative performance and that both should be understood as concurrent thinking processes. The creative cognition framework strongly supports this perspective on creative thinking. It is thus suggested that practitioners should not overemphasize the role of pure divergent or convergent thinking, that are, for instance, taught as characterizing iterative stages of creativity in design thinking methods. When conducting creativity workshops, encouraging either divergent or convergent thinking may result in a decreased variety of individual forms of creative cognition and suppress a balance of these thinking processes. Instead, when practitioners want to achieve a broader variety of individual perspectives and approaches for a problem or task at hand, focusing on stimulating diverse forms of creative cognition could be more beneficial than solely encouraging divergent or convergent thinking. Hence, the framework equally offers metacognitive knowledge to leaders with respect to facilitate employee creativity. Ultimately, there is no universal tool to stimulate creative performance. Both divergent and convergent thinking processes can achieve the goals of distinct creative stages; the difference is rooted in the means—the adopted form of creative cognition—on how to achieve the goals.

5 | LIMITATIONS AND AVENUES FOR FUTURE RESEARCH

As with any research, this work is subject to limitations. As illustrated in Figure 4, all forms of creative cognition can be utilized in any stage of creativity. However, a given stage may in turn also determine the relationship between antecedents to creativity and cognitive elements of creativity. Certain antecedents have a different impact on creativity contingent on which creative stage is considered (Caniëls et al., 2014; Tolkamp et al., 2022). For example, while expected extrinsic rewards can be detrimental for idea generation, they may be beneficial for the stage of idea implementation (Caniëls et al., 2014). Hence, there are two layers to be considered—one concerning the current creativity stage and the second layer concerning the forms of creative cognition that occur within each stage. These two layers are interrelated, and the factors shaping creative thinking are suggested to have varying effects on cognitive elements of creativity contingent on the current stage. This interdependency, however, is not within the scope of the creative cognition framework. While there is abundant literature on

antecedents to creativity and their impact on creativity during certain stages, there is little evidence relating to the varying effects on how different forms of creative cognition relate to creative performance. A fruitful avenue for future research is thus to examine the indirect links as illustrated in Figure 4, which require further conceptual and empirical development.

A further limitation is that not only stages of creativity and forms of creative cognition are interrelated but also the forms of creative cognition presented in this work may be interrelated. Individuals may, for instance, generate solutions to identified problems through several ways. While initial ideas may result from experimenting with existing knowledge, further ideas may be generated more independently from existing knowledge. However, first tapping into available knowledge is a cognitive stimulation, which may subsequently impact creative thinking processes. Hence, there might be interdependencies among the forms of creative cognition contingent on the order in which individuals adopt certain forms. Moreover, creative processes in practice are nonlinear and fuzzy and barely follow prescribed sequences of thinking (Dum & Siang, 2018). In particular, design studies have shown that individuals go back and forth among ideas that have been generated throughout a creative design process (Cross, 1997). Adopting specific sequences of forms of creative cognition and iterating forward and backward among different stages and processes may in fact be a neglected aspect of metacognitive knowledge that can facilitate or hinder creative thinking. The suggested framework does not provide such detail, as it would add yet another layer of complexity. However, it should be noted that this direction is in need of further research and may benefit from an integration of evidence rooted in design research. Experimental studies could serve this purpose by varying the experimental conditions with respect to the order of how individuals should engage in creative thinking. For example, first stimulating analogical thinking through providing an example and subsequently stimulating the modification of an existing idea, and vice versa, for comparison of potential differences in creative performance. Methods from design studies, such as recording think-aloud protocols during creative processes (e.g. Dorst & Cross, 2001), could thereby deliver insights on changes in cognitive processes.

Furthermore, there are numerous peculiarities and details in extant literature on the relationship between antecedents to creativity and creative thinking that have not been addressed. As an example, one could dig deeper into different leadership styles as antecedent to creativity and how different leadership styles impact creative behaviour of employees (for a review, see Hughes et al., 2018), in particular with respect to cognitive elements of creativity. There are also further factors that have been found crucial for creative performance, such as creative self-efficacy. Yet, it was not the intention of this article and would be way beyond the scope of a single review, to provide a comprehensive and detailed overview of the vast amount of antecedents to creativity. Rather, reviewing and synthesizing extant literature supported the illustration of relationships between selected antecedents to creativity and cognitive aspects of creative thinking. By doing so, the suggested creative cognition framework offers a cohesive system of factors surrounding cognitive elements of creativity. While not

claiming to offer a comprehensive list of all factors relating to creative cognition, the strength of the framework lies in the ease of positioning existing and future research on creativity and cognition in the framework. For that purpose, it offers two dimensions, the share of novel information being processed and the dominance of divergent or convergent thinking. In particular, the framework illustrates several direct and indirect paths through which both antecedents and intended outcomes of creativity relate to cognitive elements of creativity.

Despite its limitations, this work provides conceptual guidance for promising avenues of future research. While many antecedents to creativity, and factors shaping effective creative thinking, have been explored in an organizational context, the suggested framework enables a connection between these antecedents and different forms of creative cognition. Exploring these linkages allows to enhance the understanding how certain actions and instruments aiming at stimulating creative performance impact creative thinking processes from a cognitive perspective. A more deliberate choice of actions can be achieved when it is known how these actions relate to creative cognition. The presented forms of creative cognition in fact bridge the relationship between specific creative thinking processes, such as divergent and convergent thinking, and creative ideas and thus form the basis of how individuals engage in creativity. Differences in creative cognition, however, tend to be factored out in research, although they offer great potential to enhance our understanding of creativity.

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

ORCID

Felix Pinkow  <https://orcid.org/0000-0002-3680-5682>

ENDNOTES

¹ To avoid confusion in the terminology, 'process' is only used for specific creative thinking processes, such as divergent or convergent thinking processes. In literature, the term 'process models of creativity' is also referring to stages such as problem and opportunity identification, problem definition, idea generation, or idea evaluation. In this paper, the term 'stage' is used, equally referring to the above-mentioned stages.

² It should be noted here that the term 'idea generation' is widely established in literature. Given the elaborated understanding of creative ideas, an idea does not only refer to the generation of solutions to identified problems or opportunities. The provided understanding of an idea as accumulation of individual thoughts goes way beyond the generation of solutions. An idea can also constitute an identified business opportunity or an idea concerning why a generated solution is useful and novel. Hence, ideas are generated throughout all stages. Yet, given the widespread dissemination of the term idea generation as a central stage of creativity, it will be maintained in the remainder of this paper. Nonetheless, as the core of this paper lies in disentangling cognitive processes, it is noteworthy at this point to emphasize that an idea can refer to more than merely the generation of concrete solutions.

³ Mumford et al. (2006) originally refer to 'concept' instead of knowledge in their article, which they understand as categories within which knowledge and experiences are stored. To avoid introducing further terms with overlapping meanings, the term knowledge is used here.

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AUTHOR BIOGRAPHY

Felix Pinkow holds a Master of Science in Management from University of Mannheim. Since 2018, he works as a Research Fellow and PhD candidate at the Chair of Technology and Innovation Management at Technische Universität Berlin. His primary research interests concern creativity and creative thinking processes, in particular the relationship between affect and creativity. Further research topics include open innovation, crowdsourcing and crowdfunding. His work was published in journals such as *Creativity and Innovation Management* and presented at international conferences such as the *Innovation and Product Development Management Conference*, the *JIPIM Research Forum* and the *Open and User Innovation Conference*.

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