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Neuropsychological antecedents of individual creativity within organizations

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DEDICATION

To my mom Galyna, my stepdad Yura, my brother Kostya and my grandpa Misha

Acknowledgments

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I would like to dedicate this thesis to my family. Without them, I would not have been able to make it. Our life has changed forever on February 24th 2022, and separated us across borders that cannot be easily crossed. Nonetheless, the physical distance has never stopped us from being there for one another in the most challenging of situations. I know that soon enough we will be reunited on the streets of victorious and safe Ukraine. I love you. I respect you. I learn more and more from you every single day. Slava Ukraini.

Contents

CHAPTER 1. INTRODUCTION: WHY CREATIVITY & INNOVATION: MOTIVATION BEHIND RESEARCH

This dissertation aims to highlight and advance the understanding and measurement of creativity in organizations within a research context in which the concepts of innovation and creativity require higher efforts to delimit their actual meanings and to elicit their intersections (Amabile, 1996; Anderson et al., 2014; Bledow et al., 2009; Campbell, 1960; De Jong & Den Hartog, 2010; Drazin et al., 1999; Ekvall, 1997; Gong et al., 2009; A. Hargadon & Sutton, 1997; Hennessey & Amabile, 2010). This thesis acknowledges the broader backdrop of innovation, though the main goal is to address the gaps in the theoretical knowledge relating to creativity, as well as the individual-level psychological components that contribute to the process of creativity and aid in the empirical examination of its dynamism (M. Baer & Oldham, 2006; Campbell, 1960; Drazin et al., 1999). The research presented in this dissertation is developed via three distinct papers, each contributing to this objective in its own way and adding more to the theoretical body of knowledge. The first paper systematically reviews the literature to highlight creativity and innovation; the second paper provides an enriched model for developing and exploring the individual creativity process; and the third paper empirically tests the influence of specific individual components on creativity outcomes. The dissertation aims to provide a more developed understanding of creativity within organizational settings via these three papers. By identifying how to manage creativity within the workplace, people can cultivate creativity better and be assigned tasks that foster their creative behaviors (Amabile et al., 1996). Organizations can also facilitate creativity by implementing strategies and training that can enhance individual creativity.

The dissertation recognizes the importance of creativity for organizational success, competitive advantage, and progress in various fields, especially relevant to today's competitive business world (Hennessey & Amabile, 2010).

Businesses strive for innovative improvement across all categories for multiple reasons (De Jong & Den Hartog, 2010; Gong et al., 2009).One of the latest and most significant influences on the push for innovation is the effect of digital transformation and the inspiration from emerging technologies like artificial intelligence, the Internet of Things, blockchain, and big data analytics (Andriole, 2020; Cavalcanti et al., 2022). Adopting emerging technologies into everyday life and business models has enabled organizations to enhance efficiencies and drive innovation; however, it has also provided a foundation for a more competitive world regarding the outcomes of innovation – products, processes, and people(Ekvall, 1997; Hennessey & Amabile, 2010). Digital transformation has pushed organizations to re-evaluate the old-fashioned business models and take on newer, up-to-date approaches to deliver better customer value (Andriole, 2020; Cavalcanti et al., 2022).

This is where the first gap of our research emerges. With so much pressure on providing innovative outcomes, little is known about the role of creativity in the organizational innovation process (A. Hargadon & Sutton, 1997).

Our dissertation's second gap is found in the notion that creativity plays a central role in the innovation process. It adds neuropsychological knowledge, including the relevant neuropsychological contributions to the pure management world. The second gap that we will explore in this dissertation is the lack of exploration of the neuropsychological processes within the management field and our addition to it. Coming from different strands of research and a multilayered viewpoint, creativity is known as the driver behind idea generation, problem-

solving, and the creation of a supportive organizational culture that promotes innovation (Amabile, 1988a; Amabile & Pratt, 2016a; M. Baer & Oldham, 2006; George & Zhou, 2007; Nijstad et al., 2010a). Organizations that foster creativity enhance their capabilities for innovation and develop a competitive advantage in a transforming world (Amabile, 1988a; Amabile & Pratt, 2016a; Bledow et al., 2009; Eisenberger & Shanock, 2003; Wu & Koutstaal, 2020a).

It is crucial that both creativity and innovation work on individual, group, and organizational levels. Unique skills, experiences, and perspectives that pertain to people characterize the individual level (Amabile, 1996; Anderson et al., 2014). The group level takes the unique skills and experiences developed at the individual level. It applies them by sharing ideas and collaborating to bring diverse perspectives into a group effort (Anderson et al., 2014; Bledow et al., 2009). Debates, knowledge sharing, and challenging ideas characterize group level. Creativity and innovation at the organizational level require a more systematic process by integrating a supportive and facilitative culture of creativity and innovation (Bledow et al., 2009). Different strategies and characteristics set apart individual, group, and organizational levels of creativity and innovation – from effective communication and open-mindedness at a group level to whole departments dedicated to innovation promotion on the organizational level and personality traits on the individual level (M. Baer & Oldham, 2006). A successful combination of all three levels is supposed to lead to success in creativity and innovation outcomes (Amabile, 1988a; Amabile & Pratt, 2016a; Gupta & Banerjee, 2016).

This dissertation focuses on the individual level of creativity since gaps in knowledge exist throughout all three levels. Because group and organizational level analyses are founded on individual psychological processes, understanding these individual psychological processes will

help develop new theories on the other two levels (Amabile, 1988a; Amabile & Pratt, 2016a; Gupta & Banerjee, 2016). Creative behaviors in groups and organizations will be conditioned by individual behaviors and vice versa, as shown by organizational behavior research, by beginning with the individual level, it proposes to focus on group and organizational levels afterward, building from the knowledge gained from the individual level (Amabile, 1988a; Amabile & Pratt, 2016a; Gupta & Banerjee, 2016). Considering this, all three papers that form the basis of this research will only be talking about individual levels of understanding.

CONCEPTUAL FRAMEWORK

1.2. HOW RESEARCH ON INNOVATION AND CREATIVITY HAS EVOLVED

A multidisciplinary approach must be taken when discussing individual creativity research (Amabile, 1983a, 1988a, 1996; Csikszentmihalyi, 2014; George & Zhou, 2007; Hennessey & Amabile, 2010; Hunt, 1994; Runco, 2014; Runco & Acar, 2012; Shalley et al., 2004a; Sternberg, 2006; Tierney & Farmer, 2002). Collaboration and integration between various disciplines, such as psychology, neuroscience, and management, are just some fields that have touched upon creativity and innovation. Disciplines such as engineering and computer science are also tapping into innovation, primarily if we focus on emerging technologies (Dewett, 2007). While being outside of the scope of this particular research, they should be kept in mind for further studies into creativity and innovation (Runco & Acar, 2012; Sternberg, 2006). The multidisciplinary perspective allows researchers to gain information from versatile and differing points of view to create a holistic and more complete outlook on creativity and innovation regarding theory, empirical examination, and practical implications (Runco, 2014).

Creativity and innovation have developed differently depending on the context (Csikszentmihalyi, 2014; Glăveanu, 2010a; Glăveanu, 2020). By examining both, the process and the outcomes of creativity and innovation, researchers can also obtain a more comprehensive knowledge of both constructs (Glăveanu, 2020; Hennessey & Amabile, 2010).

When speaking about creativity and innovation, researchers must consider a plethora of factors that range from individuals, as well as an environment that can affect both the process of creativity and innovation (Amabile, 1988a; Amabile et al., 1996; Amabile & Pratt, 2016a; Nijstad et al., 2010a). Understanding and exploring these factors aids in the holistic understanding of the components. Theoretical frameworks should also always consider the

practical applications of the concepts in various contexts, for example, facilitating strategies that promote creativity and innovation within organizations (Amabile, 1983a, 1988a; Amabile et al., 1996; Amabile & Pratt, 2016a).

Research on creativity and innovation has a long-standing history that has undergone many different changes (Amabile, 1983a, 1988a; Amabile & Pratt, 2016a; Nijstad et al., 2010a). Throughout the years, creativity and innovation research have overlapped since their conceptualization needed more clarity in the theoretical body of knowledge (Runco, 2014). Nonetheless, many different theories on creativity and innovation and how both of the constructs originated have been explored by researchers (Hennessey & Amabile, 2010; Hunt, 1994).

The earliest years of research focused more on creativity and the different cognitive processes that could be involved in the process of creativity, which is still being explored nowadays, with the help of new up-to-date technologies, such as neuroimaging techniques (Boden, 2003). Later, researchers studying creativity and innovation attracted more disciplines, creating even more confusion (Csikszentmihalyi, 2014). Topics such as leadership or organizational culture have become prominent in innovation research, focusing on practical applications within organizations (Amabile, 1988a; Amabile & Pratt, 2016a). Risk-taking and knowledge sharing, as well as collaboration, began themes of research, especially within the field of organizational innovation.

Progress in biomedicine and neuroscience has contributed to the field of creativity and innovation in recent years (Amer et al., 2016a; Beaty et al., 2015, 2017; Beaty & Silvia, 2012). Genetic underpinnings and neural mechanisms of creativity have highlighted the knowledge that has been unknown by creativity and innovation literature up to this date (Amer et al., 2016a; Beaty et al., 2015, 2017; Beaty & Silvia, 2012).

Apart from that, new emerging technologies, as well as waves of research, have affected the research on creativity and innovation – themes such as sustainability, corporate social responsibility, digital transformation, and others are now being researched (Csikszentmihalyi, 1998). New emerging technologies have influenced creativity and innovation in a great way, not only by providing new avenues for problem-solving coming from artificial intelligence and big data but also by creating technologies that allow individuals to participate in collaboration and knowledge sharing immediately (Runco & Acar, 2012). Globalization of the modern world and the interconnectedness between individuals has also profoundly impacted creativity and innovation, now bringing in variables like collaboration across cultures and diversity and the challenges this brings for generating and implementing new and useful ideas (Bodla et al., 2018; Hundschell et al., 2022; J. Kim & Song, 2021; Tripathi & Ghosh, 2020). Research has focused on topics like cultural diversity and the ways it can influence creativity and innovation positively or negatively (Csikszentmihalyi, 1998; Glăveanu, 2020). As innovation and creativity are such prominent research themes and influence the competitive advantage of organizations, research has also focused on how they can influence those around them; therefore, ethics and social responsibility topics have been added to the research on creativity and innovation (Amabile, 1988a; Amabile & Pratt, 2016a; Runco & Acar, 2012).

To summarize, research on creativity and innovation has expanded throughout the years and responded to societal changes and the environmental context, but the importance has not changed, and much is yet unknown about how both creativity and innovation are cultivated and which strategies should be used to promote creativity and innovation within organizations.

The section below presents some of the most prominent theories on the focus concept of the dissertation, creativity, that have emerged throughout history.

1.2.1. MAIN THEORIES ON RESEARCH IN CREATIVITY WITHIN ORGANISATIONS

1.2.1.1 Cognitive theories

Cognitive theories of creativity talk about the cognitive capacities and psychological processes relevant to creative thinking (Amabile, 1983a; J. Baer, 2012; Hennessey & Amabile, 2010). Some similarities with trait theories exist in that these theories are also focused on individual capacities and abilities (e.g., divergent thinking); however, new lines of thought and research have stemmed from this particular branch of exploration into creativity (Sawyer, 2006).

Various researchers in this area identified many psychological processes critical for creative thinking and creativity (e.g., attention, memory, etc.). (Hunt, 1994). Researchers specify that these different cognitive processes work together to generate successful creative ideas (Amer et al., 2016a; Beaty et al., 2014, 2015, 2016a, 2017; Kenett et al., 2016)). Compared with other theories based on personality, cognitive theories acknowledge the importance of the context on creative thinking and abilities (Tanggaard, 2013). This is something that has often been criticized. While cognitive theories are similarly mostly focused on individual psychological characteristics, the mention of cultural relevance to these characteristics takes cognitive theories one step further in theoretical development compared to the other theories (Lubart, 1999).

Cognitive theories highlight that learning and increasing one's creative abilities can be honed through instruction and application (Plucker & Renzulli, 2014). Cognitive theories emphasize the role of gained knowledge and domain expertise in creative abilities (R. W. R. W. Weisberg, 2006). Cognitive theories also emphasize how structure and limitations can aid in the

process of creative thinking, a notion that wasn't explored in the other psychological theories of creativity (such as personality theories) and that has been researched within organizational and management literature (Nijstad et al., 2003). Certain restrictions, for example, imposed by organizational cultures, actually may aid individuals in thinking of new ways to solve existing problems and provide different perspectives (Csikszentmihalyi, 1998).

Some of the most prominent existing cognitive theories are the **Conceptual Combination Theory, Mediated Learning Experience Theory, the Four-C Model of Creativity, and the Creative Cognition Approach;** however, there are many more (J. C. Kaufman & Beghetto, 2009; Mumford, 2003; Runco & Jaeger, 2012; Silvia et al., 2009; Sternberg, 2003).

Conceptual Combination Theory

This theory presupposes that creativity does not come out of anything but is instead a merger of notions that are already present within an individual's mind in approaches that are new and not thought of before (Boden, 2003; Guilford, 1950, 1959b; Mednick, 1962). Individuals are, therefore, able to trigger a plethora of cognitive processes together and merge them into a new idea that is both novel and useful (Runco & Jaeger, 2012). A plethora of different creative activities are explained by this theory, including but not limited to humor, language evolution, cultural changes, artistic expression, etc., and this theory views these processes as the creation of new perspectives through the combination of psychological processes that already exist previously (Cropley, 2006; Hunt, 1994; Sawyer, 2006). This theory discusses the importance of structure and limitations for engaging and facilitating creative thinking to force individuals to think of novel solutions and approaches to existing problems (Cropley, 2006). It also talks about

the relevance of having a flexible mind and the ability to switch between different alternatives to combine ideas faster, which is also explored within this dissertation (Christensen & Schunn, 2007). Conceptual Combination Theory considers the cultural factors and how they can change and form the mental spaces and the cognitive processes individuals need to create newly generated ideas (Glăveanu, 2010a; Lubart, 2001). This theory has been criticized that, even though it mentions cultural factors, it puts too much emphasis on internal ongoing cognitive processes and does not consider societal changes as much as it should.

Mediated Learning Experience Theory

This theory does take into account the environment; in fact, it takes place at the center of the formulation of the theory (Amabile, 1997; Csikszentmihalyi, 1998). Creativity, according to this theory, comes from when individuals interact with the outside world. People will then utilize the cognitive techniques available to engage with the environment and societal changes and adjust according to the changes happening, which can aid them in problem-solving (J. Baer, 2012; Guilford, 1950, 1959b; Sternberg, 2006). To do that, people need to learn how to interact with the environment; therefore, developing cognitive tools useful for successful integration is the key to this theory; the more developed the cognitive mechanisms are, the better the creative outcomes will be (Ekvall, 1997; Gajda et al., 2017; Glăveanu, 2010b; Hennessey & Amabile, 2010; Kim, 2011; Nijstad et al., 2003; Plucker et al., 2004; Sternberg & Lubart, 2014). Mediated Learning Experience Theory puts a lot of importance on those that can aid others in understanding how to successfully hone their creative skills, considering the integration between the individual and the environment (Amabile, 1997; Csikszentmihalyi, 1998; Gajda et al., 2017; Hennessey & Amabile, 2010; Mumford, 2003; Plucker et al., 2004; Scott et al., 2004; Sternberg

& Lubart, 2014). It puts much emphasis on nurturing and learning vs. nature and predisposed abilities, which is different to some of the theories introduced beforehand (Dollinger & Shafran, 2005; Guilford, 1959b). This theory is applied in a variety of settings, including but not limited to organizations, psychotherapy, and educational settings (Amabile, 1997; Csikszentmihalyi, 1998; Ekvall, 1997)). This theory has received some criticisms, with researchers pointing out that, again the innate 'cognitive tools' are overly emphasized, leaving the impression that one needs to be born with some basic level of cognitive tools that can later be learned; other criticisms include the absence of empirical examination and, therefore, lack of validity of the theory (Gajda et al., 2017; Plucker et al., 2004)(Gajda et al., 2017; Plucker et al., 2004). Following that, some critics also point to the fact that the theory does not have specific cognitive techniques that can facilitate and enhance creativity, it just tends to speak in more general terms (Amabile, 1997; Csikszentmihalyi, 1998; Hunt, 1994; Lubart, 1999; Mumford, 2003; Plucker et al., 2004; Sternberg, 2006).

Four-C Model of Creativity

This is a theory that studies creativity and talks about mental processes that occur within the process of creativity (Amabile, 1983a; Csikszentmihalyi, 1998; Guilford, 1968; J. C. Kaufman & Beghetto, 2009; Plucker et al., 2004; Runco & Acar, 2012; Simonton, 1999; Smolucha & Gardner, 1984; Sternberg & Lubart, 2014). It presents 4 different types of creativity, which signify how creativity can be differentiated depending on which setting the generated idea took place or what characteristics the generated idea undertakes:

1. **Mini-c:** *everyday creativity*; this is creativity that individuals can engage in that can happen on a daily basis, whether it's in personal life or in a professional

setting. Mini-c doesn't have a formal structure and it usually tends to happen on impulse without any previous preparation. Other people might not consider it of value (Hennessey & Amabile, 2010; J. C. Kaufman & Beghetto, 2009)

2. **Little-c:** *personal creativity*; this creativity is very domain-specific; and can be considered novel, as well as useful for others but within a specific setting. The use of domain expertise and previous knowledge is essential in order to generate something creative for that specific domain (Feist, 1998a; J. C. Kaufman & Beghetto, 2009).
3. **Pro-c**: *professional creativity*; this type of creativity is also domain-specific but is considered valuable by authority figures within a specific field. This creativity requires a large amount of knowledge and generates something new within that field. This type of creativity and the previous one differs in the degree of acknowledgment that the generated idea is given within the field. While little-c creativity might be helpful in being successful in a domain, it's not substantial enough to be disruptive within the domain and even outside the domain (F Barron & Harrington, 2003; J. C. Kaufman & Baer, 2012).
4. **Big-C:** *eminent creativity*; this level of creativity brings significant change to the outside world within a particular domain, however affecting society in one way or another. This type of creativity requires a great level of domain expertise, as well as the ability to generate something novel and useful, something that leaves a lasting impression on society (Guilford, 1968; J. C. Kaufman & Beghetto, 2009).

Each subsequent type represents a creative idea that requires more knowledge base and difficult, as well as distinct mental processes and tools to generate that creative idea (Lubart,

1999, 2001). The Four-C Model of creativity emphasizes the learning process within the domain of creativity, with people being able to hone their knowledge within particular domains to achieve higher levels of creativity (Cropley, 2006; Lubart, 1999). It also considers societal factors; with an understanding that certain creative ideas and inventions might only be recognized as such by that particular culture, and other cultures might have a different view on these ideas (Eisenberger & Shanock, 2003; K. H. Kim, 2008).

This model is very practical and applicable because it promotes the facilitation of creativity thinking and learning within individuals to have an impact on the societal world. It has applications in a variety of fields, ranging from music, science to education and businesses (Scott et al., 2004). It is useful because it allows for appreciation of different forms and expressions of creativity, regardless of whether it is personal everyday spontaneous accomplishments in creating something novel and useful or something more groundbreaking on a more societal level (Guilford, 1968). Criticisms of this model include the absence of specificity of clear characteristics of each of the types of creativity and that the lines between moving from one level of creativity to the next seem to be blurred (J. Baer & Kaufman, 2008; Plucker et al., 2004). Other criticisms include an overemphasis on the end product of creativity, largely ignoring the entire process of it, overlooking the psychological processes that might underline expression of different types of creativity (Csikszentmihalyi, 1998; Lubart, 1999).

Creative Cognition Approach

This is another cognitive theory of creativity that talks about psychological processes and their influence on creative idea generation (e.g. attention, memory, perception) (Cropley, 2006; Hunt, 1994; Mednick, 1962; Runco, 2014; Smith & Blankenship, 1991; Ward, 1994; R. W.

Weisberg, 1993)(. This theory mentions divergent and convergent thinking (Cropley, 2006; Csikszentmihalyi, 1998; Guilford, 1968; Lubart, 1999; Sternberg & Lubart, 2014) as well as the cultivation of creativity as a result of integration of multiple existing ideas in a novel and useful way, in a similar way with other cognitive theories. According to the authors of the theory, individuals undergo different psychological processes to engage in creative thinking and generate a new idea (Hunt, 1994):

- **Associative Thinking:** creative ideas are generated when an individual can connect different types of ideas that don't appear to have the ability to be connected to one another (Mednick, 1962).
- **Conceptual Expansion:** converting and increasing the limits of already existing ideas permits people to look at things from a different point of view and aids in creative idea generation (Hunt, 1994; R. W. Weisberg, 1993) .
- **Analogical Thinking:** making associations between different fields to gain new perspectives on a problem (R. W. Weisberg, 1993).
- **Defocused Attention**: when individuals engage in creative thinking, oftentimes they have to allow different ideas to enter into the mind and not focus on one specific task in mind, to permit a variety of different ideas and alternative methods for problem-solving to enter into the thought process (Smith & Blankenship, 1991).
- **Metaphorical Thinking:** individuals can utilize more analogies or speculative terms and figures of speech to describe different ideas to permit associations between unconnected constructs (Hunt, 1994).

According to the Creative Cognition Approach, creative thinking often involves a necessary level of domain expertise since it allows individuals to see missing solutions to

problems or associate different concepts together within that domain (Boden, 2003; R. W. Weisberg, 1993). While the Creative Cognition Approach can be utilized for practical applications in a variety of domains, it does have limitations in regard to lacking the explanation of how the outside world can change creative thinking and underlying cognitive processes. Apart from that, the theory seems to focus more on creative outputs instead of the process itself. Critics point to the importance of paying attention to how the cognitive processes underlined in this theory affect different parts of the creativity process in distinct ways (J. Baer, 1998; Sawyer, 2006)(.

In general, cognitive theories have become very significant in the research and understanding of the process of creativity; mostly looking into the way the underlying psychological processes and cognitive functions work when presented with an opportunity to create new alternative solutions for already existing problems or generate creative ideas (Sawyer, 2006). Cognitive theories, overall, also seem to point to the importance and relevance of learning and domain expertise individuals' possess in order to better their creative outputs (Simonton, 1999). Many of the cognitive theories seem to have similar types of criticisms, with some exceptions: while the importance of psychological and cognitive processes are essential for understanding the process of creativity, it is of equal importance to study and research the effect of the ever-changing societal world on these underlying cognitive processes (Runco & Jaeger, 2012; Sternberg & Lubart, 2014)(Runco & Jaeger, 2012; Sternberg & Lubart, 2014). It is essential to learn how the underlying cognitive processes and society can affect creative thinking and engage in creative tasks in conjunction with one another (Hunt, 1994; Runco & Jaeger, 2012). Apart from that, it seems that just applying cognitive theories to study the process of

creativity is not enough, there should be different disciplines and different trains of thought that can complement the knowledge that comes from creativity from cognitive theories (Hunt, 1994).

1.2.1.2 Social-psychological theories

In comparison with cognitive theories, social-psychological theories point towards the importance of societal factors first and their effect on the process of creativity (Amabile, 1983a; J. Baer & Kaufman, 2008; Csikszentmihalyi, 1998; Hennessey & Amabile, 2010; Sawyer, 2006; Tierney & Farmer, 2002), however, also show the relevance of individual factors and how they influence creativity(J. C. Kaufman & Baer, 2012; Tierney & Farmer, 2002). They consider cognitive factors, as well as the different traits (e.g. personality) (Oldham & Cummings, 1996); and motivational factors that can affect the expression of creativity in these individuals (Deci & Ryan, 2008; Eisenberger & Shanock, 2003)**.** Creativity is a multifaceted construct (Deci & Ryan, 2008). These theories, while different, share certain similarities, such as the expression of individual predispositions constantly affected by societal changes and structures (Perry-Smith & Shalley, 2003).

This structure can either increase or decrease the expression of creativity in individuals, depending on the societal factors that are affecting the individuals (Shalley & Gilson, 2004). Social-psychological theories also consider communication and collaboration between people to cultivate creativity (A. B. Hargadon & Bechky, 2006; Perry-Smith & Shalley, 2003). They recognize that idea, often, does not just appear as a result of individual thinking, but as an outcome of knowledge sharing and viewing things from multiple perspectives, communication, and discussion (Sawyer, 2006). Social-psychological theories also put a big emphasis on motivation and how it affects the process of creativity or engaging in projects that are considered

creative, including both intrinsic, and extrinsic motivation (Deci & Ryan, 2008; Tierney & Farmer, 2002). Apart from that, and similar to specific cognitive theories, social-psychological theories display the relevance of learning from other people, as well as other sources of informational learning (e.g., educational programs, workshops, media) to hone creative skills and facilitate higher creative output (Nijstad et al., 2003). These theories also consider that successful creative ideas are not only novel but also useful, which requires an outside look at it. The outside recognition of the creative product is a big part of the creative idea being accepted within society and meeting the standards that are set by societal or organizational structures for novel and useful approaches to already existing ideas (Anderson et al., 2014). These theories mention a variety of factors such as diversity and globalization and their influence on creativity and how it develops through these societal changes (Hekman et al., 2017; J. C. Kaufman & Baer, 2012). These theories, therefore, aim to offer a framework that helps with understanding and future exploration of the combined effect of individual internal predispositions and societal influences on the creative process (Anderson et al., 2014; Csikszentmihalyi, 1998; George & Zhou, 2007; Hennessey & Amabile, 2010; Runco & Acar, 2012).

Some of the most prominent existing social-psychological theories are Amabile's Componential Model of Creativity, Csikszentmihalyi's Systems Model of Creativity, the Consensual Assessment Technique, the Social Identity Theory of Creativity, Social Exchange Theory, Self-Determination Theory of Creativity, The Flow Theory of Creativity, Expectancy Value Theory of Creativity; however, there are many more (Csikszentmihalyi, 1998; Hennessey & Amabile, 2010; Runco & Acar, 2012).

Amabile's Componential Model of Creativity

This theory of creativity views creativity as the interaction between three main components that make up three big groups of different processes:

- ***Domain-relevant* skills:** this is the expertise that individuals engaging in creative processes gain or already possess and, according to Amabile, a basic knowledge of the particular domain that the creative idea is being generated with is needed (Amabile, 1983a; Hennessey & Amabile, 2010).
- ***Creativity-relevant processes:*** psychological and cognitive processes that individuals have that have been found to be relevant to the creative process (e.g., personality, memory, attention, etc.) (Csikszentmihalyi, 1998; Nijstad et al., 2003; Sawyer, 2006).
- ***Task motivation*:** motivation that individuals have to participate in creative activities (Deci & Ryan, 2008; Tierney & Farmer, 2002).

The componential model of creativity is the main theory this dissertation stands on. It's one of the most well-known and complete theories of creativity and innovation, focusing on different components and societal factors that can affect both processes (Hennessey & Amabile, 2010). In comparison to many other theories of creativity, this model takes into account the process of creativity and not just its outcomes (Sternberg & Lubart, 2014). Some of the most essential characteristics of Amabile's Componential Model of Creativity include the associations and relationships that happen between domain-relevant skills, creativity-relevant skills, and task motivation and how these components affect the stages of creativity wide range of factors can influence unique and different ways depending on the stage they are in (J. Baer & Kaufman, 2008; J. C. Kaufman & Baer, 2012; Oldham & Cummings, 1996). Amabile's componential

model of creativity is specifically relevant for organizational contexts as it attempts to facilitate creativity within organizations (George & Zhou, 2007; Perry-Smith & Shalley, 2003).

Some people criticize the componential model of creativity for its focus on the components and not enough focus on the societal factors or the context in which creativity is cultivated. Some researchers point to the fact that the componential model of creativity focuses too much on differentiating the different components, and, therefore, cannot look at creativity more holistically. The theory also received criticism due to the fact that there has not been much empirical examination that can provide evidence of the fact that the model works, something that the authors of the model point towards themselves (Runco & Acar, 2012; Shalley & Gilson, 2004)).

Csikszentmihalyi's Systems Model of Creativity

This theory views creativity as a way of communication between the individual, the field, and the domain (Amabile, 1988a, 1997; Hunt, 1994). This theory views creativity as a multifaceted process dependent upon many factors (J. Baer & Kaufman, 2008; Csikszentmihalyi, 1998; Guilford, 1950; Smolucha & Gardner, 1984). This theory views the cultivation of creativity as the input coming from:

- **The individual:** personality (e.g., openness to experience), cognitive processes, etc., but people who don't have the predispositions for certain individual traits are also able to achieve success with creative tasks if they are provided with support and motivation to do it (Guilford, 1950; J. C. Kaufman & Beghetto, 2009).

- **The domain:** the level of expertise that this individual has acquired knowledge to successfully take part in the creative task at hand and the field this individual specializes in. Creative output must, therefore, be considered valuable within this specific domain. With the help of support from the field, an individual can have a higher success rate due to the availability of resources needed for creative idea generation (J. Baer, 2012; Lubart, 1999).
- **The field:** the societal and cultural factors and structures surrounding the expression of this creative work since this is where the creative idea will be judged to be either useful or not useful. The surrounding environment can either hinder or facilitate creativity expression (Glăveanu, 2013; Tanggaard, 2013).

In general, this model of creativity has been applied to a variety of contexts and looked at through different research studies, regardless of this some criticize it for the lack of specificity between how the individual, domain, and field interact with one another.(Hennessey, 2000). Without these clear relationship specifics, it is difficult to conduct empirical research that can check strategies to facilitate creativity based on this model. In comparison to other models, this one gets criticism for focusing too much on the context and the judgment of others, and not enough on the individual predispositions one might possess for creativity (Mumford & Gustafson, 1988; Runco & Acar, 2012).

Runco's Consensual Assessment Technique (CAT)

This theory views creativity as a social construct, and its cultivation is reliant upon the recognition of those who have in-depth domain expertise in the domain in which the creative idea is being generated (Amabile, 1983a; J. Baer et al., 2004). CAT, therefore, considers the

social and cultural factors that influence the generation of creative ideas and not just the individual predispositions that some might possess beforehand (Cropley, 2006; Hunt, 1994). Creativity is recognized as a complex construct that changes depending on the context in which it originated (Guilford, 1959a; Paulus & Nijstad, 2003). CAT is a method for judging the creative output's good or bad by asking the experts to rank the creative idea through characteristics such as originality, effectiveness and appropriateness (J. Baer & Kaufman, 2008; K. H. Kim, 2008). Because of the reliance on other people to rate creative outputs, CAT has often been criticized for its lack of objective measurements of creativity; however, it has been found to have good reliability and validity through different research studies (Hennessey & Amabile, 2010; Plucker et al., 2004). Other criticisms include the large amount of time it takes in order to administer CAT, as well as the extensive use of resources and reliance on the knowledge base of the invited experts (Mumford, 2003; Sternberg & Lubart, 2014). Due to this, CAT might not be the best technique to evaluate or theorize creativity as it cannot be applied to many different contexts. Because it is applied with such specificity in mind in regards to a domain, it cannot sometimes understand the full process of creativity and focuses on the outcomes instead of the dynamic nature of creativity, something that has been criticized in research for many theories of creativity (Runco & Acar, 2012). Apart from that, CAT cannot conceptualize creativity as a construct properly. While relying on experts within the same field to judge how creative an idea might be proves due to their expertise and knowledge base, their understanding of the construct might differ and might skew the results (Sternberg, 1985; Sternberg & Lubart, 2014). Apart from that experts within specific fields have similar types of backgrounds for their knowledge base, so the produced creative idea isn’t viewed from a multiple perspective point of view and, therefore, might lack diversity (Paulus & Nijstad, 2003; Shalley et al., 2004a).

Flow Theory of Creativity

Creativity is viewed as the outcome of a mental state that is called “flow” that features undivided attention to the task in hand and total and absolute immersion without any distractions (Csikszentmihalyi, 1998; Shernoff et al., 2003; Wilder et al., 1989). According to the authors of this theory, the state of flow is ideal for creativity as it completely immerses an individual in the task, and nothing else distracts that person (Deci & Ryan, 1985; Jackson & Csikszentmihalyi, 1999; Keller & Bless, 2008). This theory says that creative ideas are much more likely to be achieved when an individual is in this zone and in a state of flow)(Jackson & Csikszentmihalyi, 1999). It also suggests that creative idea generation is not a predisposition that people need to possess. Still, instead, it is the combination of the skills along with the context that plays a significant role in whether an individual can achieve this state of flow (Csikszentmihalyi, 1998, 2014). Authors say that challenging activities that are still achievable within an individual’s domain expertise are much more likely to facilitate creativity and creative idea generation (Nakamura, J., & Csikszentmihalyi, 2014). The optimal level of difficulty of the task in hand plays an essential role since a low level of difficulty for that individual results in a loss of motivation, boredom, and not achievement of the state of flow, and too high causes anxiety and stress, resulting in a similar thing (Csikszentmihalyi, 1998; Nakamura, J., & Csikszentmihalyi, 2014; Wilder et al., 1989). Different results apart from increased creativity have been shown to occur due to being in the state of flow, including but not limited to a higher sense of well-being, motivation or, specifically, intrinsic motivation, overall level of satisfaction, etc. (Fave & Massimini, 2012; Good et al., 2016).This theory is helpful because it explains how creativity can be cultivated, as well as specific concepts that can contribute to facilitation of creativity,

however, it does produce specific criticisms. Some research shows that the flow theory of creativity does not apply to group or organizational creativity where knowledge sharing and communication are essential since it requires a very individual level of consciousness to achieve the flow state (Csikszentmihalyi, 1998; Nakamura, J., & Csikszentmihalyi, 2014; Wilder et al., 1989). Apart from that, the flow theory of creativity needs more empirical examination and evidence for how the state of flow can cause creative output and that the association between the two is much more intricate than previously put forward (Nakamura, J., & Csikszentmihalyi, 2014). The conceptualization of the state of flow needs to be looked at further, with the conditions of how to achieve the state of flow described in more detail (Hektner, 2007; Shernoff et al., 2003).

Self-determination theory

This theory views creativity as a construct influenced when individuals feel a sense of competence, autonomy, and relatedness (Deci & Ryan, 1985; Ryan & Deci, 2000).

- **Competence**: a knowledge base and domain expertise that individuals have to give them a sense that they are good or competent enough to engage in the activity and successfully generate creative ideas (Vansteenkiste et al., 2004). A sense of competence can increase motivation to engage in creative endeavors (Black & Deci, 2000).
- **Autonomy**: the feeling of people's independence regarding decision-making processes in the activity they are engaging in. It gives people a sense of control and can motivate them to work harder on the task (Reeve, 2009).

- **Relatedness**: when one participates in creative activities, one can feel connected and relate to others via knowledge sharing and collaboration. This creates a positive environment for creative idea generation (Grant, 2012).

Self-determination theory takes into account the fact that creativity does not just come from predisposed individual factors but is shaped by the environment in which the creation of that idea takes place. The environment and the context can either facilitate creativity and the factors that are important in influencing its expression (autonomy, competence, and relatedness) or hinder it by affecting the individual's state of autonomy, presenting a challenge too complicated, or creating an environment that does not allow for collaboration (Gagné & Deci, 2005). While valuable and applicable throughout different contexts, this theory needs more empirical evidence, especially on the intricacies of the relationship of autonomy, competence, and relatedness with the outcomes of creativity – the generated creative idea. One of the other criticisms of this theory results in ignoring extrinsic motivation and only talking about intrinsic motivation, even though there is research and evidence that rewards can impact engaging in creative activities and outcomes (Ryan & Deci, 2000).

Social identity theory of creativity

This theory suggests that creativity is cultivated through a social identity that people build up and from the different social groups they take part in throughout their lives (Tajfel & Turner, 1979; Turner, 1981). The group that people are a part of it based on different characteristics, such as ethnicity, gender, and other influence on their daily behaviors, including those associated with creativity (Hogg & Terry, 2000). Being a part of different groups throughout one's life allows people to express themselves creatively to highlight the successes of the group or show

the group off to other groups (Jetten, 2012). It also serves a purpose of being recognized within the group itself (Jetten, 2012)**.** Engaging in creative activities may also be diminished by the group that individuals belong to. In certain situations, group values and norms hinder creative expression (Van Knippenberg et al., 2004). Depending on the behaviors and the outcomes, individuals may have changes in their self-esteem, social identity, and belonging to the group (Homan et al., 2015). At times, being a part of the group may negatively affect creativity in instances of groupthink where new and unusual ideas are not accepted since everyone wants to reach a mutual agreement (Paulus & Nijstad, 2003). This, combined with a lack of diversity in one group, can create an environment where multiple perspectives are not looked at, limiting individuals from searching for alternative ideas and creating connections that could lead to successful creative outcomes (Nemeth & Staw, 1989). The social identity theory also mentions a sense of competition, where external rewards are relevant when competing in creative endeavors against similar groups (Hong & Page, 2001). This theory received a few criticisms, such as the lack of attention paid to individual traits and characteristics that may shape creativity and too much focus on how the group identity and the context can shape it (Kurtzberg & Amabile, 2001). Other researchers also point out that similar expressions of groups may have different creative outcomes precisely because of the different individuals and individual traits that they're bringing to the table, even if, on paper, the groups' descriptions might seem similar (Hong & Page, 2001; Tajfel & Turner, 1979). Apart from that, the evidence seems to lack an explanation for how power dynamics can affect the expression of creativity, whether it can facilitate or hinder it. Regardless, the social identity theory seems to attract much attention from the scientific community and places the role of context in a central spot for understanding the process of creativity, something that many other theories have not done (Sawyer, 2006).

Social cognitive theory

This theory says that creativity results from individual predispositions, the social context, and other factors. The social cognitive theory views creativity as a collaborative process or "distributed creativity" that needs different individuals' perspectives and willingness to share and communicate their knowledge to one another (Sawyer, 2006). By providing recognition, space for feedback, and learning, creativity can be fostered and honed (Perry-Smith & Shalley, 2003). This way, their predispositions and cognitive processes, such as cognitive flexibility, memory, attention, etc., can aid others where they are lacking and provide a collaborative environment where an even more fantastic creative output can be produced (Paulus, 2000). According to this theory, creativity is a result of this collaboration and not just an outcome of individual traits and characteristics, a constructed that social cognitive theory calls "emergent creativity" (Amabile, 1997). Creativity, therefore, is heavily dependent upon the environment that it is being cultivated in; social and context, and the different cultural factors that can influence its expression (J. Baer, 2012). Critics of this theory point to the need for more clarity and specificity of how creativity can be facilitated in different contexts and domains and that it is and challenging to test it empirically (Glăveanu, 2013). While it emphasizes the role of collaboration and other relevant factors, it seems to overlook the precise individual components that are needed for the cultivation of creativity and that have been shown in research to play a role in successful creative expression (Cropley, 2006). Despite that, this theory has provided a way to understand how complex the process of creativity is, and shows the interplay between cognitive and social factors, which is sometimes overlooked in other theories.

Overall, social psychological theories view creativity from various perspectives; pointing to the importance of different variables and factors that can contribute to the expression of creativity or hinder it. These theories consider the complex interplay of various relationships that take place in the process of creativity and the need for their theoretical understanding and empirical examination (Nijstad et al., 2003). In general, social psychological theories of creativity have greatly impacted the research of the construct and its understanding (Nijstad et al., 2003). The theoretical evidence they provide should be considered when attempting to study further and understand creativity (Gajda et al., 2017). While some limitations and criticism have been shown to be relevant for further research, these theories are central to research and their applicability in practice (Paulus & Brown, 2007).

1.2.1.3 Neuroscience-based theories of creativity

Neuroscientific research has been at the forefront of research of creativity, especially recently with the development of new technologies and neuroimaging methods (Dietrich, 2007; Glăveanu & Kaufman, 2019). This technology can answer certain questions that were previously only poised in models and theories without empirical examination or evidence (Beaty et al., 2016a). Neural networks that activate during a creative task can now provide information that was not readily available before regarding the cognitive and mental processes that can then influence creative behaviors (Jung & Haier, 2007). Apart from that, neuroscience can see the way that context can affect the activation of the neural networks and brain pathways that have been associated with creative potential and creative thinking (Benedek, Jauk, Fink, et al., 2014; Benedek, Jauk, Sommer, et al., 2014). Neuroscience can also provide information on where in the brain creativity is cultivated and originates (Abraham, 2013). It views creativity as a

multifaceted construct that is a constant interaction between the neural networks brain regions, and cognitive processes (Arden et al., 2010).

Neuroscience-based theories; therefore, many times start with the parts of the brain that activate during a creative activity and then go into the variety of cognitive processes that are implemented within the process (Dietrich & Kanso, 2010). Many theories coming from neuroscientific research also position creativity not as a consistent and unwavering process but rather as one that can be activated by different stimuli and activate various brain regions and networks that will, therefore, mediate, influence, and involve distinct cognitive processes ranging from memory, attention, fluid intelligence, etc. (Kounios & Beeman, 2014).Theories based in neuroscientific research provide a new level of understanding of creativity and a helpful way to look at individual creativity from within, starting on a neural basis (Beaty et al., 2015). If research pays attention to the way creativity is cultivated within the brain. In that case, it might be able to learn more regarding the cognitive and mental processes that later on translate into behaviors and willingness to engage in creative activities, as well as the predisposition for creative potential (Kenett et al., 2016). Understanding the neural and brain mechanisms of creative potential can provide an opportunity for strategy creation to facilitate creative expression in many domains (Hunt, 1994; Ward, 1994). Many theories exist that are based on neuroscientific research; some of the most prominent ones are the Frontal Lobe Hypothesis, The Default Network Hypothesis, the Associative Theory of Creativity, the Divergent Thinking Theory, and the Cognitive Flexibility theory; however, there are many other theories that exist and many of them overlap with one another in the knowledge that they bring regarding creativity (Arden et al., 2010; Beaty et al., 2016a; Fink & Benedek, 2014; Gilhooly et al., 2007; Kenett et al., 2016; Runco, 2014; Vartanian et al., 2007).

The Frontal Lobe Hypothesis

Prefrontal cortex has been found to be involved in various cognitive functions (Arden et al., 2010). This theory says that creativity and creative thinking are also cultivated from the work of the prefrontal cortex (Dietrich, 2004; Martindale, 2014). Studies show that damage to the prefrontal cortex causes a diminishing ability in creative thinking(Andrews-Hanna et al., 2010; Boccia et al., 2015, 2016). On the other hand, neuroimaging methods such as transcranial direct stimulation show that stimulating the prefrontal cortex increases creative behavior and creative thinking, as well as a higher creative output (e.g., generation of better creative ideas) (A. E. Green et al., 2015; Howard-Jones et al., 2005). The Frontal Lobe Hypothesis is useful for organizations and business endeavors since it sheds light and provides a better understanding of how creativity is cultivated and creativity is one of the crucial aspects that is relevant for competitive advantage within organizations (Paulus & Brown, 2010; Runco, 2014). It helps us understand neural and cognitive processes that occur during creative thinking, and, therefore, can provide a useful baseline for organizations for strategy creating with the aim of increasing creativity. A significant criticism of this theory is the disregard of other neural and brain networks that are involved in creative thinking and the overemphasis on the prefrontal cortex (Beaty et al., 2014; Benedek, Jauk, Fink, et al., 2014; Benedek, Schickel, et al., 2014). This criticism on an overemphasis on the prefrontal cortex can also lead to the fact that the theory isn’t specific enough in regards to not taking into consideration how individuals may utilize different brain regions or neural networks for creative thinking depending on the context (Sternberg, 2003). Some research has shown that certain types of creative expression, such as art,

music, or dance, involve a variety of brain networks that are associated with emotional processing (Boccia et al., 2016; Kowatari et al., 2009; Liu et al., 2012).

The Default Network Hypothesis

This theory says that creativity activates the brain's default mode network which is an area with a few brain regions that generally activate when individuals are not thinking about anything in particular and are just letting their mind wander (Andrews-Hanna et al., 2010; Kucyi & Davis, 2014). Research has found that this set of brain areas activates when people engage in creative tasks and that the DMN itself is responsible for increasing the expression of creative behavior by enhancing the possibility for distinct brain regions to interact with one another for the brain to be able to make connections in a way that wasn't possible before (Beaty et al., 2016a; Kenett et al., 2016), in a flexible way which aids in the generation of ideas that are both novel and useful (Jung & Vartanian, 2018). Indeed, much evidence has shown a positive association between the activation of the DMN and creative thinking and creative behaviors (Boccia et al., 2015; Fink & Benedek, 2014). An interesting discovery that was made regarding creative thinking and one that thesis looks into further is the fact that the DMN is not the only network of brain regions that activates during a creativity task; however, executive control network regions or the ECN are also active (Chrysikou & Thompson-Schill, 2011). Researchers contribute it to the different cognitive processes that play at hand when individuals engage in creative tasks, with the necessity to let one's mind wander at certain stages evaluate all the proposed ideas, and select the best one at other stages, a function that ECN is responsible for (Beaty et al., 2015, 2017). Another network that is implicated in creative thinking and aligned with the Default Network Hypothesis is the salience network (Uddin, 2015). The salience

network is responsible for taking that creative idea and allowing the individual to focus and not let distracting stimuli enter the brain to guarantee a successful execution of the process of creative idea generation (Liu et al., 2015). According to this theory, the DMN, the ECN, and the salience networks, have an on-going interaction when individuals engage in creative thinking (Shen et al., 2017). Some studies separate the creative process into two stages – with the first one being the creative idea generation and the second one being the creative idea self-evaluation. DMN seems to be more active in the first and the ECN in the second (A. E. Green et al., 2015). Some studies, however, show that the activation of the DMN might not necessarily pinpoint to creative thinking but other cognitive functions that are unaccounted for (K. C. R. Fox et al., 2018). Another significant criticism of the theory is that it doesn't establish a causal relationship between the activation of the DMN network brain regions and individual predispositions for creativity and creative thinking. Researchers still cannot tell whether DMN is the brain region that is responsible for an individual's ability to think creatively or there might be some other variables and factors that do that and the DMN activation is just a consequence of those factors (Dietrich & Haider, 2015).

The Associative Theory of Creativity

This theory says that creativity and creative thinking is a result of make new connections between previously existing notions. Neuroscientific research points towards a variety of brain regions and networks that can be involved in creativity that were mentioned beforehand, and this theory, while focusing on cognitive aspects of creativity, is considered a neuroscience-based one since it bases its explanations on neuroscientific evidence (De Pisapia et al., 2016; Hunt, 1994; Kozbelt et al., 2010; Simonton, 2003). It says that by researching and relying on the evidence of

activation of the brain regions and networks, researchers can now pinpoint the cognitive pathways that can be involved in creative thinking (Jackson & Csikszentmihalyi, 1999; Mirvis & Csikszentmihalyi, 1991). The hallmark of the theory is that different people can utilize their domain expertise and previous knowledge base and experiences they have to make these associations and generate creative ideas (Guilford, 1950, 1959b; J. C. Kaufman & Beghetto, 2009). Associative theory of creativity talks about the process of divergent thinking where the creative idea generation happens that then later on is followed by an idea evaluation stage or something that is called convergent thinking (Carson et al., 2005; Nijstad et al., 2003; Paulus & Nijstad). This is supported by neuroscientific evidence that shows the creative idea generation process as a two-stage process – with idea generation happening first and followed by creative idea evaluation (Kenett et al., 2016)). The associative Theory of creativity specifies that this engagement in creative thinking is not domain-specific and can happen in various fields and domains (Sawyer, 2004, 2006). It also takes into account cognitive and affective processes that are relevant for creative thinking (Amabile et al., 2005; Benedek, Jauk, Fink, et al., 2014; Benedek, Schickel, et al., 2014), and talks about different factors and constructs that have shown to have a relationship with creativity and creative thinking (Plucker et al., 2004). This theory is sometimes criticized for the lack of specificity in regards to which factors contribute to making better associations for creative idea generation; the lack of focus on individual differences between people in regards to how it affects creativity; it also does not look at other factors apart from cognitive factors that are able to affect creativity (e.g., personality; social context, etc) (Lubart, 1999; Runco, 2014). Similar to other theories of creativity, there is a lack of a causal relationship between making connections that are considered new and valuable and creative thinking abilities, which is something that future research needs to focus on (Ward, 1994).

Divergent theory of creativity

This theory says that creativity is a product of divergent thinking; that it's the capability of an individual to generate a variety of new creative ideas (Beaty et al., 2017; Beaty & Silvia, 2012; Benedek & Neubauer, 2013; Hennessey & Amabile, 2010; J. C. Kaufman & Baer, 2012; Kozbelt et al., 2010). This theory says that those people who are considered to be creative can come up with 'outside the box' ideas that are outside of the scope of what is considered a standard way of thinking (Lubart, 1999). It specifies that divergent thinking involves the ability for flexibility, fluency, and originality (Guilford, 1950, 1959b; Hunt, 1994; J. C. Kaufman & Baer, 2012).

- **Flexibility**: the capability to create ideas that belong to different categories (Chrysikou & Thompson-Schill, 2011; Cropley, 2006).
- **Fluency**: capability to create many ideas at ones (Benedek & Neubauer, 2013).
- **Originality**: capability of generating ideas that are unusual and not conventional (Hennessey & Amabile, 2010; Mumford, 2003).

This theory says that individuals can learn to be creative (Sawyer, 2004)(Sawyer, 2004). Divergent Theory takes more into account the variety and the number of ideas that one generates, vs. Associative Theory looks at how new and good the idea is (J. Baer & Kaufman, 2008; Benedek & Neubauer, 2013; Hennessey & Amabile, 2010; J. C. Kaufman & Baer, 2012; Runco & Acar, 2012; Runco & Jaeger, 2012). The criticisms for Divergent the Associative Theories of Creativity are similar mentioning lack of specificity, lack of focus on individual differences, and, importantly, lack of casual relationships (Dijksterhuis & Meurs,

2006; Martindale, 2014; Plucker et al., 2004; Simonton, 1999; Sternberg & Lubart, 2014; Vartanian et al., 2007)

Cognitive Flexibility Theory

This theory says that creativity is a result of a shift between different mental representations and perspectives. Many studies have shown that the ability to switch between different ideas, different views and let one's mind wander has been associated with higher levels of creative output (Beaty et al., 2015, 2017; Chrysikou & Thompson-Schill, 2011; Colzato et al., 2012; Dietrich, 2004; Ellamil et al., 2012; Kenett et al., 2016). Shifting between different perspectives allows individuals to recognize and identify those relationships that were not visible beforehand and make new associations that can help generate creative ideas (Fink & Benedek, 2014; Fink & Neubauer, 2006; Kasof, 1997; Mednick, 1962). Cognitive flexibility theory says that creativity is not domain-specific, and shifting between different types of mindsets can be applied to many different fields (Guilford, 1959a). Neuroscientific evidence suggests that cognitive flexibility and cognitive persistence are two cognitive pathways that people utilize when they engage in creative thinking. This corresponds with neuroscientific findings of two patterns of brain connectivity – between mind-wandering and cognitive control. With cognitive flexibility being responsible for a shift in perspective and persistence, allowing an individual to focus on pertinent information and ignore distracting stimuli, it aligns with the idea that the creativity process is part of the first stage of creative idea generation and the second stage of creative idea evaluation (Kounios et al., 2008; Kounios & Beeman, 2014; Takeuchi et al., 2010a, 2010b). Cognitive flexibility theory needs more empirical examination to be able to establish the causal relationship between the construct and creative outcomes; as well as to understand what

would be a better way of operationalizing it. These criticisms partially come from the lack of specificity of the theory and the fact that it doesn't explore the individual differences that people might have in regard to their ability to shift between different perspectives and other factors such as memory, personality attention, etc. that might affect cognitive flexibility (Beaty et al., 2014, 2015, 2016a, 2017; Beaty & Silvia, 2012; Kenett et al., 2016).

Overall, there are many more existing theories of creativity. The theories that are presented above aim to capture a holistic understanding of the state-of-the-art research on creativity within organisations throughout the years and how different perspectives and views can change the understanding and the conceptualization of creativity (Runco & Jaeger, 2012; Silvia et al., 2008).

1.3. MAIN CONTRIBUTIONS OF THE CURRENT DISSERTATION

This dissertation focuses on the individual level of creativity, a starting point when understanding creativity and innovation. Overall, this dissertation is composed of three different works – the first one is a review, the second one – is a conceptual model, and the third one is an empirical examination of cognitive flexibility, cognitive persistence, and individual components such as personality and affect and their influence on creativity outcomes.

Table 1. The three papers within the dissertation

Number of the paper	Name of the paper
1.	Conceptualizing cognitive and behavioral elements of individual's creativity and

	innovation: systematic literature review
2.	Opening doors to Neuropsychology: Integrating the DPMC model into the componential model to enrich the conceptualization of individual creativity within organizations.
3.	Investigating the complexity of creativity: the mediating role of cognitive flexibility and persistence in relationship between personality, affect and creativity outcomes

1.3.1. CONCEPTUALIZING COGNITIVE AND BEHAVIORAL ELEMENTS OF INDIVIDUAL'S CREATIVITY AND INNOVATION: SYSTEMATIC LITERATURE REVIEW (Paper 1)

The first paper aims to address various gaps in the literature that are present with the processes of creativity and innovation.

The paper looks at the confusion and lack of clarity when understanding the constructs and the relationship between them. Drawing from the lack of clarity, the systematic literature review points towards discrepancies in differentiating creativity and innovation that have emerged in the literature. It also points to insubstantial information available on the

psychological underpinnings of creativity and innovation specifically within organizational and management literature. This research puts an emphasis on the psychological and cognitive underpinnings of the constructs because they form the basis of the individual level of creativity and innovation since we are talking about people's behavior. It suggests that organizational and management research lacks the knowledge available in other kinds of literature – neuroscientific and cognitive theories of creativity; since it can bring more enriched and up-to-date information on individuals. This lack of information from neurobiological and cognitive psychology fields results in the lack of consensus and understanding of which components can influence individual creativity and innovation across different stages of the processes themselves.

In terms of main results, the paper positions creativity as a construct that happens before innovation and the first step necessary for innovation. It looks at the prominent theories of creativity. It identifies Amabile's componential model of creativity and innovation as one of the longest-standing, yet relevant frameworks of the process of creativity and innovation. According to Amabile, creativity is the generation of novel and useful ideas, and innovation is the implementation of the creative idea generated during the creative process. According to Amabile, innovation cannot exist without creativity since no idea would have been generated without its process. It also shows the cognitive and psychological components of individual creativity and innovation relevant to the organizational context and aids in achieving idea generation and implementation. In doing so, it displays the relevance of neuropsychological literature in studying creativity and innovation within organizational and managerial contexts. The review further discusses certain psychological and cognitive components that pertain to neuroscientific and psychological evidence, such as cognitive flexibility and persistence and their influence on the creative process.

The first paper contributes to the theoretical body of knowledge by integrating theories and research from multiple disciplines. It highlights a variety of multifaceted literature, including that coming from neurobiological and cognitive psychology backgrounds, to display the role played by creatitivity in the innovation process within organizations, and points towards its relevance in today's competitive world for fostering strategies that enhance innovation within organizations and economies. It identifies a theoretical gap in the literature regarding conceptualizing creativity and innovation constructs and how they are managed differently by different disciplines and research works. It, therefore, builds upon relevant literature to position creativity and innovation as separate constructs and understand the intricacies of their relationship. Finally, it highlights the importance of empirical examination and the need for a conceptual and theoretical building to delineate the relationship between the two constructs. It also points towards the competitive advantage of today's world and how studying creativity and innovation is crucial for practical reasons within organizations.

1.3.2. OPENING DOORS TO NEUROPSYCHOLOGY: INTEGRATION DE DPMC MODEL INTO THE COMPONENTIAL MODEL TO ENRICH THE CONCEPTUALIZATION OF INDIVIDUAL CREATIVITY WITHIN ORGANISATIONS (Paper 2)

The second paper poses a variety of research questions in order to be able to fill the gaps found in theoretical knowledge from the literature review in paper 1.

The second paper builds upon the systematic literature review and provides the basis for the enriched model of creativity that is the main contribution of this work. This paper attempts to integrate neuropsychological literature and organizational and management literature to bridge that gap introduced within the literature review in the previous paper.

It presupposes the conceptualizations of creativity and innovation introduced by Amabile, proven by other prominent researchers, and places creativity as a necessary predecessor to the innovation process. Therefore, it highlights another theoretical gap where much of the research on innovation has overlapped with the research on creativity. It proposes to begin by focusing on the individual level of creativity before moving on to innovation processes.

Amabile's componential model of creativity provides the basis for research from the organizational point of view. It shows the importance of dynamism in the research of creativity since much research has focused on the end-goals of it and has disregarded the fact that it is a process. This point is stressed in the paper as another theoretical gap in the body of knowledge in the literature on creativity. This paper contributed to this gap of knowledge by developing an enriched model of creativity based on the componential model – one of the only existing models that considers the dynamism of creativity as a stage-by-stage process that is influenced by different components. It complements the componential model with the knowledge from neuroscientific research, which the first paper pointed out was lacking within organizational and managerial literature.

The dual-pathway model of creativity, a neuropsychological model, sheds new light on cognitive components such as cognitive flexibility and cognitive persistence that are proposed to be used as mediators for creativity and influenced by individual components already present within the componential model. This integration of the componential model and DPMC is proposed as a contribution that can provide insights lacking within organizational literature and shed light on the relationship patterns between individual components and their effect on creativity, another gap in theory found by the literature review. Precise relationships between variables within the creative process need further research since they have not been

appropriately examined, especially when focusing on dynamism and not on creativity's end goal and outcomes.

The enriched model offers the basis for future research to explore the individual components and their relationship patterns with creativity through the provided mediators, which are the central constructs of the enriched model – cognitive flexibility and persistence, in-depth. Cognitive flexibility and cognitive persistence are cognitive constructs that have been found to be heavily involved in the process of creativity within neuropsychological research. Research specifies that cognitive flexibility is the ability of individuals to alternate between ideas, vs. persistence is the ability to attend to certain stimuli with undivided attention. The constant interplay between the two modes of thinking is involved within creative idea generation and explained in a more significant deal within the papers.

This model can be used within organizational settings to allow for the facilitation of developing strategies that are based on individual differences to increase creativity in a managerial context. The model provides practical applications that can promote creativity and, therefore, offers approaches for assessment and empirical examination of the dynamic process of creativity, which prominent authors have claimed to be missing from creativity research and calls for the lack of consistency when measuring creativity. Future research must focus on developing accurate and reliable methods for measuring creativity, and the enriched model can be utilized to aid in that process. The model is also flexible to be complemented further with individual components as they are researched in future studies.

1.3.3. COGNITIVE FLEXIBILITY AND PERSISTENCE AS PROXIES FOR MEASURING INDIVIDUAL CREATIVITY: POSITIVE RELATIONSHIP BETWEEN OPENESS TO EXPERIENCE, POSITIVE AFFECT AND HIGHER SWITCH COUNT IN CREATIVE TASKS IN COMPARISON TO ROUTING TASKS (Paper 3)

The third paper explores the theoretical gaps that were addressed both in the literature review (paper 1), and in the enriched model (paper 2). The paper addresses the methodological limitations that have been present in previous studies. These gaps include the lack of empirical examination of the dynamic process of creativity and the need for it for organizational and managerial settings to properly pipeline and enhance it within those contexts. This paper utilizes the introduced cognitive flexibility and persistence pathways from the enhanced model. It provides more evidence of the lack of research regarding the specificity of the relationship between cognitive pathways and the process of creativity. It aims to address this gap in the knowledge.

This paper contributes by attempting to measure the effect of cognitive flexibility and persistence on the process of creativity, as well as the influence of specific individual components identified in the enriched model of creativity paper, such as personality and positive and negative affect. Another gap the paper addresses is the effect that situational and dispositional components have on cognitive flexibility and persistence. It does so by utilizing a recently developed technique called Self-Guided Transitions that can measure cognitive flexibility and persistence in a more natural setting compared to the measurements that were utilized before. By examining individual components such as cognitive flexibility and persistence, this study provides a much more comprehensive analysis of the creative process. It is the first study, to our knowledge, to utilize individual component measurements along with Self-

Guided Transitions to measure the creative process in a dynamic way and in a natural setting. It is also the first paper of its kind, to the best of our knowledge, that can aid in the potential implementation of using cognitive flexibility and cognitive persistence as proxies for measuring creativity in the future. It does so by comparing cognitive flexibility and persistence measurements between creative tasks (e.g., Alternative Uses Task) and routine tasks that were found to be examples of those routine tasks normally present within organizational settings.

1.4. BRIDGING THE THREE PAPERS TO CREATE A COMMON RESEARCH CONTRIBUTION

Table 2 summarizes the research questions, main results, and contributions of the three papers presented in this dissertation

Name of the paper	Research questions	Main results	Contributions
Conceptualizing cognitive and behavioral elements of individual's creativity and innovation: systematic literature review	1. How can creativity and innovation be conceptualized separately to create a consensus within the literature? 2. What are the neurological, cognitive, and psychological	1. The first paper differentiates creativity and innovation in the literature and points towards the discrepancies in the literature of the two constructs. 2. It highlights that	1. Addresses the theoretical gap and provides a conceptualization of creativity and innovation as separate processes. 2. Identifies creativity as the

	components influencing individual creativity and innovation? 3. How can neurological, cognitive, and psychological constructs aid in understanding creativity and innovation processes?	creativity comes before innovation and is a necessary precursor for innovation to occur. 3. It also showcases the importance of neuropsychological underpinnings of individual creativity research. It suggests further exploring the insights from the neuropsychological body of knowledge to enrich the current understanding of individual creativity. 4. The systematic literature review stresses the integration of multiple	predecessor of innovation, with the creative idea generation being a necessary step for innovation to begin. 3. Identifies and displays neuropsychological components relevant to the creativity and innovation processes. 4. Stresses the necessity of studying creativity and innovation in the organizational setting and integrating

		multidisciplinary theories and emphasizes the role of creativity in innovation; it also underscores the relevance of this research for researchers since it highlights success in the competitive organizational world.	neuropsychological literature to enhance knowledge. 5. Conducts a systematic literature review that integrates theories and research from different disciplines, further advancing to the academic understanding of creativity and innovation.
Opening doors to Neuropsychology: Integrating the DPMC model into the componential	1. How can neuropsychological knowledge be integrated into	1. This paper attempts to bridge the gap between neuropsychological literature and	1. Builds upon the systematic literature review to put forward a new understanding of

model to enrich conceptualization of individual creativity within organizations.	organizational and managerial research with the goal of understanding creativity? 2. How can the componential model of creativity and the DPMC model be combined to enhance the understanding of the process of creativity? 3. What are the neuropsycholo gical components that influence creativity?	organizational and managerial research originally proposed in the first paper. It integrates knowledge from both neuropsychology and managerial and organizational research to increase the understanding of the process of individual creativity. 6. It provides an enriched model of creativity, which is based on Amabile's componential model of creativity and focuses on it as a dynamic process	creativity by integrating neuropsychologica l evidence into the organizational context. 2. Combines the componential model of creativity with the dual-pathway model of creativity for an enriched model of creativity in organizations. 3. Introduces cognitive flexibility and persistence to act as proxies for the process of individual creativity.

	4. How do cognitive flexibility and persistence can act as mediators to influence the process of creativity through different stages? 5. How can individual components affect cognitive flexibility and persistence through different stages of the creative process? 6. Which effect	vs. a static one that is influenced by a variety of individual & neuropsychological components. The componential model of creativity is integrated with the insights that come from neuropsychological research coming from the Dual Pathway Model of Creativity which introduces two cognitive pathways – cognitive flexibility and persistence – into the componential model of creativity	4. Offers a model that allows for further research into the individual components influencing creativity and their relationship with cognitive flexibility and cognitive persistence. 8. Switch attention from focusing on creativity outputs to researching the dynamic processes of creativity.

	do individual components have on the process of creativity?	in the hopes of acting as mediators for the process of creativity. 7. The enriched model of creativity, therefore, is proposed to serve as a basis for future research that will explore the individual components and their relationship with creativity through the provided cognitive pathways acting as mediators. It proposes the use of the model in organization contexts and for	

		further empirical examination and a flexibility of the model for future research with more individual components having a possibility of being added to the model.	

INVESTIGATING THE COMPLEXITY OF CREATIVITY: THE MEDIATING ROLE OF COGNITIVE FLEXIBILITY AND PERSISTENCE IN THE RELATIONSHIP BETWEEN PERSONALITY, AFFECT AND CREATIVITY OUTCOMES	1. What is the difference in the cognitive flexibility and persistence measurements between creative and routine tasks? 2. How do individual components, such as personality and positive & negative affect, associate with cognitive flexibility and persistence? 3. Is there a positive relationship	1. Paper 3 empirically examines the part of the enriched model proposed in Paper 2. It measures the impact of cognitive flexibility and persistence on the creative process and the impact of individual components, personality traits, and positive/negative affect. 1. The study found a	1. Introducing empirical examination of a dynamic conceptual framework of creativity. 2. Uses Self-Guided Transitions technique to measure cognitive flexibility and persistence in natural settings. 3. Shows that personality and positive and negative affect have a significant

	between openness to experience and cognitive flexibility? 4. Is there a positive relationship between positive affect and cognitive flexibility? Does higher cognitive flexibility predict	significant effect of personality traits, specifically openness to experience; as well as positive and negative affect on creativity outcomes. 2. The study found a non-significant effect of cognitive flexibility and persistence on creativity outcomes.	relationship with creative outcomes.

		3. Paper 3 suggests the utilization of cognitive flexibility and persistence as proxies for measuring creativity in the future.	

All three papers presented in this dissertation unveil the topic of creativity step-by-step, starting with theoretical exploration and ending with an empirical examination of the constructs. They showcase the importance of both processes for competitive advantage and success within the organizational and managerial settings. All three papers address the theoretical gaps in the current body of research regarding the concepts of creativity and innovation within the organizational context and provide enriched theoretical understanding. They all aim to close theoretical gaps found regarding the conceptualization of the processes and highlight the importance of the individual psychological and neuroscientific components that can influence them throughout different stages.

The contributions of the three papers are consecutive, with the second paper building upon the results of the literature review of the first paper, and the third paper taking the knowledge from the enriched model and attempting to empirically examine it in a natural setting. Three papers, therefore, form a natural progression of research with all of them recognizing the significance of individual creativity and innovation for organization and their attempt to solve the provided theoretical gaps. Overall, all three papers contribute to the theoretical and practical knowledge of creativity and innovation in organizational contexts.

CHAPTER 2

CONCEPTUALIZING COGNITIVE AND BEHAVIORAL ELEMENTS OF INDIVIDUAL'S CREATIVITY AND INNOVATION: SYSTEMATIC LITERATURE REVIEW

ABSTRACT

The topic of individual creativity and innovation is important in today's world because companies and organizations strive for development in every possible way. Despite such demand for creativity and innovation, one definition does not exist for either creativity nor innovation that is commonly accepted among academics or people that work in the industry. This systematic literature review attempted to close this gap by looking at literature from ~~reviews from~~ different disciplines related to neuropsychology and management to highlight the literature conceptualizing individual creativity and innovation and delineating the constructs themsevles. Apart from that, the factors that underlie individual creativity and innovation are unknown and when research has attempted to investigate these concepts, it has focused on the constructs from a singular viewpoint, which does not provide a full framework for such multifaceted concepts. To address this second gap in the literature, this review attempted to identify individual behavioral and cognitive factors embedded within creativity and innovation processes.

KEYWORDS*:* creativity, innovation, cognition, personality, motivation, organizations

INTRODUCTION

One major problem in advancing the understanding of innovation in organizations and economies is the obscurity of innovation creation processes, particularly in what refers to its relationship with creativity. Creativity and innovation are two critical concepts in the industry and have become widely researched topics in the academic world (Paulus, Baruah, and Kenworthy 2018). Innovation is the driver for progress in the modern world and it permits organizations and businesses to achieve and sustain competitive advantage over other companies (Hughes et al. 2018). It is considered the drive for the survival of ~~the~~ organizations and their potential growth and one of the main measures of team success (Bisbe and Malaguenõ 2015; Madrid, Niven, and Vasquez 2019). Furthermore, innovation in organizations is crucial for policy makers as it fosters the growth of the so-called knowledge economy, it is also key for achieving rapid scientific and technological advances happening in recent decades (Powell and Snellman 2004).

Scientific evidence and intuitive understanding point to a strong relationship between creativity and innovation (Acar, Tarakci, and van Knippenberg 2019; Aldave et al. 2019; Hughes et al. 2018; Leung and Wang 2015; Tang 2019). Despite that, the differentiation between the two constructs has missed the mark in recent literature (Thayer, Petruzzelli, and McClurg 2018). It is particularly important to understand the differences between creativity and innovation, to shed light on the conceptualization of both constructs separately, before understanding their relationship – and it is a constant problem among the researchers who study creativity and innovation (Hughes et al. 2018). The multidisciplinary research undertaken with regards to both creativity and innovation has partially caused the confusion in understanding the conceptualization of the constructs and led to many discrepancies within the findings (Aldave et al. 2019; Hughes et al. 2018; Hülsheger, Anderson, and Salgado 2009; Lin and Sanders 2017;

Tang 2019). Amabile and Pratt (2016) stated that that conceptualization of these factors and further understanding of the "individual-level psychological processes" is necessary from a theoretical point of view since it will allow shedding light on both conceptualization, as well as adding to theory building. A systematic literature review is, therefore, necessary in order to gather and understand prior knowledge regarding the identified problems and as a tool for allowing researchers to "more easily identify gaps in the body of literature and potential avenues for future research (Kraus et al., 2022, p. 2578)(Kraus et al., 2022, p. 2578)." Apart from that a systematic literature review in a topic will be able to highlight the critical issues, promote further research, as well as question the pre-established notions of the topic (Kraus et al., 2022)(Kraus et al., 2022).

The first purpose of this review is to fill that theoretical gap and highlight the literature conceptualizing creativity and innovation and delineating the constructs themselves.

It does so by looking at the major theories of creativity and innovation within organizations put forward in recent years. This review specifically aims to solve the conceptualization discrepancy by looking at evidence from the latest version of the componential model of creativity and innovation (Amabile and Pratt 2016), which is the most prominent model of creativity coming from an organizational context.-Within the model, the concepts of creativity and innovation emerge to be distinct processes with creativity encompassing the generation of novel and useful ideas; and emerging as the necessary step for innovation to happen (Amabile and Pratt 2016). Innovation is positioned after creativity, relating to the implementation of creative ideas (Amabile and Pratt 2016).

Recent literature has pointed to the importance of psychological underpinnings relating it to successful engagement and outcomes of creativity and innovation processes (Acar et al. 2019;

van Knippenberg 2017). For example, according to recent literature, strategies that influence advances within technology and science rely on "intellectual capabilities" compared to other inputs (Amabile and Pratt 2016; Powell and Snellman 2004:199). However, individual's psychological elements are the ones that have been largely ignored by the organizational and management literature, bringing forth knowledge from neurobiology that's been missing within the organizational research (van Knippenberg 2017; Perry-Smith and Mannucci 2017). Thus, the second purpose of this review is to identify individual's psychological components embedded within the creativity and innovation processes, and to specifically focus on the behavioral and cognitive underpinnings of these processes. This purpose intends to display the components that psychological and management literature finds relevant for the creativity and innovation constructs, however, still fairly recent in the management literature and rarely applicable within the organizational context (van Knippenberg 2017; Perry-Smith and Mannucci 2017).

In psychological and management literature, both creativity and innovation have a place at the individual, group, and organizational levels and it is of value to delineate the different processes that are actors within each stage (Hülsheger et al. 2009; Sijbom, Janssen, and Van Yperen 2015; Tang 2019; Thayer et al. 2018). The variables affecting different stages are useful for further implementation of strategies within organizations that can lead to greater creative and innovative outcomes, therefore, the variables themselves are important to study. This review focused specifically on individual creativity because looking at all levels would require a much larger scope and review of studies, which are worth their own review processes. Lack of knowledge stems on all levels, not just individual, however, starting with individual constructs is a natural stepping-stone to open up a stage for further exploration of organizational and institutional aspects in the future once the individual level becomes clearer. Consequently, this

review focuses on the cognitive and behavioral elements of individual creativity and innovation found in psychological and managerial papers, to provide a more holistic understanding of the processes. Taking this into account, the scope of the paper is purely psychological and managerial, embedded within the organizational context. Other disciplines, such as engineering and computer science have researched the concept of creativity and innovation as well and bring substantial knowledge in regards to innovation, they are outside the scope of this paper.

This review also makes a more practical contribution. While this review is focused on the cognitive and behavioral elements involved in the processes of individual creativity and innovation and is largely based in the management context, it is important to highlight how innovation and creativity have affected the economy of an ever-changing world to further highlight the relevance of studying it (Powell and Snellman 2004). In fact, due to the increase of scientific industries and how much they have affected the economic world, researchers have noted "new kind of jobs and novel forms of work organization" that have appeared over the past few years due to an increase in this demand for innovation and production (Powell and Snellman 2004:200). In fact, a big strand of knowledge economy research has focused on continuous organizational innovation and how to transfer the successful innovation within one firm and apply it to another firm; as well as what exactly increases and/or decreases idea generation within organizations (Powell and Snellman 2004). By providing cognitive and behavioral elements that contribute to the process of creativity and innovation, we can help build knowledge within the management discipline and, in the future, create a conceptual framework that helps foster idea generation and its further implementation within organizations.

Because of this demand for innovation, it is crucial to determine specific strategies that help increase the amount of innovation within organizations and the variables that affect them.

To do that, the first step is to present a clear differentiation between creativity and innovation to create a consensus within the academic literature.

SYSTEMATIC LITERATURE REVIEW PROCESS

The section below describes the systematic review process step by step that was followed in this paper. It talks about the search strategy and the methodology used in the paper.

METHODOLOGY

A systematic literature review is a very specific method of searching that provides a full theoretical framework that finds reviews and evaluates the data gathered and the investigations ~~done~~ relevant to the research questions proposed in the studies, within the area of interest and the topic proposed. A systematic literature review follows a transparent step-by-step process that can be easily replicable by those wishing to follow it again (Aldave et al. 2019; Araki and Peres 2018; Keele 2007; MacDonald 2014).

First, the objectives of the study were identified that helped guide the research towards well-planned research questions and the methods that are used to follow through with the review in a correct manner. Afterward, the studies are identified and analyzed for their relevance and reviewed accordingly to the inclusion and exclusion criteria previously established. The findings and the results will show the data extracted from the chosen reviews and their relation with the proposed research questions.

OBJECTIVES

This paper carried out a systematic review to discriminate between the constructs of creativity and innovations on individual levels, as well as to identify various cognitive, physiological, social, and environmental variables that can affect creativity and innovation – both fostering or hindering them.

As mentioned previously, both creativity and innovation are important, highly relevant concepts in today's business and organizational world (Aldave et al. 2019; Madrid et al. 2019; Tang 2019), however, there is confusion about the proper definition of either one (Hughes et al. 2018). Some studies point to creativity being part of the innovation process, whereas others separate the two completely. Apart from failing to define important notions like creativity and innovation, it is crucial to be able to tease out the variety of variables that can affect creativity and innovation. Here, many studies diverge with differentiating individual creativity and innovation and the differences in variables that can affect the two. Therefore, this paper will focus on the identification of the notions at hand, as well as the variables affecting them with the ultimate future goal of setting a theoretical framework based on their relationship and the variables that affect them.

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SEARCH STRATEGY

Web of Science database was used to search for various papers relevant to the topic. Web of Science and not other academic databases was chosen because it appears as the most accurate based on "the classification subject" (Singh et al. 2020:2471). Apart from that, Web of Science is considered the one used the most frequently for "bibliometric research and is considered the

“industry standard” in most disciplines.” (Hernández-Torrano and Ho 2021:102). Apart from that, the use of one database with a time constraint in the field of creativity and innovation literature and, specifically, reviews has helped ~~to~~ guarantee up-to-date information from the most reliable sources (Acar et al. 2019).

Different inclusion and exclusion criteria were identified so that the search would be followed systematically. All the papers found had to be reviews from the past five years, embedded in management and psychology-related disciplines, in English and only quartiles 1 and 2 were chosen for the final selection of papers. Since they were reviews of the literature and included academic knowledge from previous years, the five-year cut-off was chosen to avoid repetition and to gather as much state-of-the-art knowledge as possible. This is particularly relevant for the fields related to neurobiology since; research in biomedical sciences specifies the importance of up-to-date information, and a time filler is necessary to get this newer information (Acar et al. 2019; Xiao and Watson 2019). In fact, the strategy for limiting the time frame to include recent literature is frequently used for systematic literature reviews to allow for a better synthesis of information (Acar et al. 2019; Xiao and Watson 2019). Apart from that, the search used keywords and “Boolean logic and search statements,” which allows for more reproducibility and is recommended in systematic literature searches.

In the Web of Science advanced search, a series of searches were conducted following the inclusion and exclusion criteria. The studies were selected based on the content of the objectives and ~~the~~ research questions poised above. Relevant articles were pooled with an overall multidisciplinary look at the question, looking at papers with the holistic view defined within the organizational management discipline, with disciplines either branches of psychology or branches of organizational theory.

Search strings	***Inclusion criteria***
TS=(creativ* AND performance)	Relevance
TS=(creativ* AND leadership)	English
TS=(creativ* AND innovation)	Reviews
TS=(creativ* AND cognition)	Articles after 2015
TS=(creativ* AND personality)	Quartile 1 and Quartile 2 only

The first search looked at ‘creativity’ and ‘innovation’ with keywords: (TS = ‘creativ* AND innovation’). The search offered 168 reviews, after the initial filtering 8 reviews were left for further observation.

The further identification of the keywords followed a search strategy via identifying some of the most commonly used and relevant keywords in the first 168 reviews identified in the first search, keywords that related to neurobiology and management for creativity and innovation. This is a method identified in previous literature for the proper identification of keywords for further searches (Hernández-Torrano and Ho 2021).

Many keywords used in the first 168 papers included ‘employee creativity’ or ‘radical innovation,’ which would not help with further searches since they included the keywords already used in the first search. After careful synthesis of the keywords, some have emerged to be popular within the Author keywords and "Plus" keywords shown on the Web of Science. Transformational, empowering, transactional, authentic and other types of leadership were common keywords, therefore, leadership became a keyword that was chosen to be used for the purposes of this paper as well. As commonly as leadership appeared among the keywords, the managerial papers of the first 168 reviews included ‘performance’ in the keywords and, it therefore, was chosen for this paper as well. Different types of keywords appeared that encompassed the construct of cognition, many times appearing such as ‘individual factors’ along with ‘cognition’ itself. Cognition was chosen as the next keyword because it appeared mostly in neurobiological literature and encompassed an umbrella for the other keywords used. Closely related to ‘cognition’, ‘personality’ or ‘big5’ appeared as keywords in many neuroscientific papers and “personality” was chosen to be a keyword for this review due to its frequency in the keyword appearances. ‘Motivation’ didn’t appear as frequently as the other keywords mentioned, however, it made an appearance in both organizational, managerial and neuropsychological literature, showing its relevance to the organizational context, and therefore was chosen for this review as well.

The literature evidences the relevance of the componential model of creativity and innovation in organizations (Amabile and Pratt 2016). Amabile’s theoretical framework helped secure the keywords chosen from the first search relevant to the processes of creativity and innovation within the organizational context since they appeared within her work as well. This review wanted to provide information on cognitive and behavioral elements relevant to the

processes of individual creativity and innovation lacking within the organizational and management literature. Amabile's componential model highlighted the relevance of creativity-relevant processes related to cognition, therefore, cognition as a keyword was justified for further search strategies. Within the creativity-relevant processes, personality has emerged as one of the essential components influencing the process of creativity and, therefore, its inclusion in the search process was further justified. Performance appeared to be one of the relevant constructs important for the organizational context, specifically, and one prominent component that shows the success of the creativity and innovation processes. Leadership, another component that influences how creative and innovative the work environment can be, was prominent throughout the componential model of creativity and became the other keyword for the systematic search. Motivation is one of the most important keywords within the componential model of creativity, therefore, it provided further justification for its inclusion within the search process.

To sum up, the keywords identified were 'creativity,' 'innovation,' 'leadership,' 'cognition,' 'performance,' 'motivation', and 'personality.'

Therefore, the further search strategies that followed focused on these keywords identified. Amabile's componential model showed creativity and innovation as distinct processes and creativity being the necessary step for innovation to happen (Amabile and Pratt 2016). In fact, since the end product of creativity (the generated idea) is essential for innovation to even occur, we decided to first focus on creativity with the identified keywords to be able to identify behavioral and cognitive elements affecting the process of creativity within the organizational context before moving on to innovation (Amabile and Pratt 2016).

Second search used the keywords 'creativity' and 'performance:' (TS='creativ* AND performance'). This search showed 280 reviews from the past five years; after filtering out the

third and the fourth quartiles and those reviews that appeared irrelevant to the research questions or the objectives according to their titles or abstracts; 29 papers were selected for further observation.

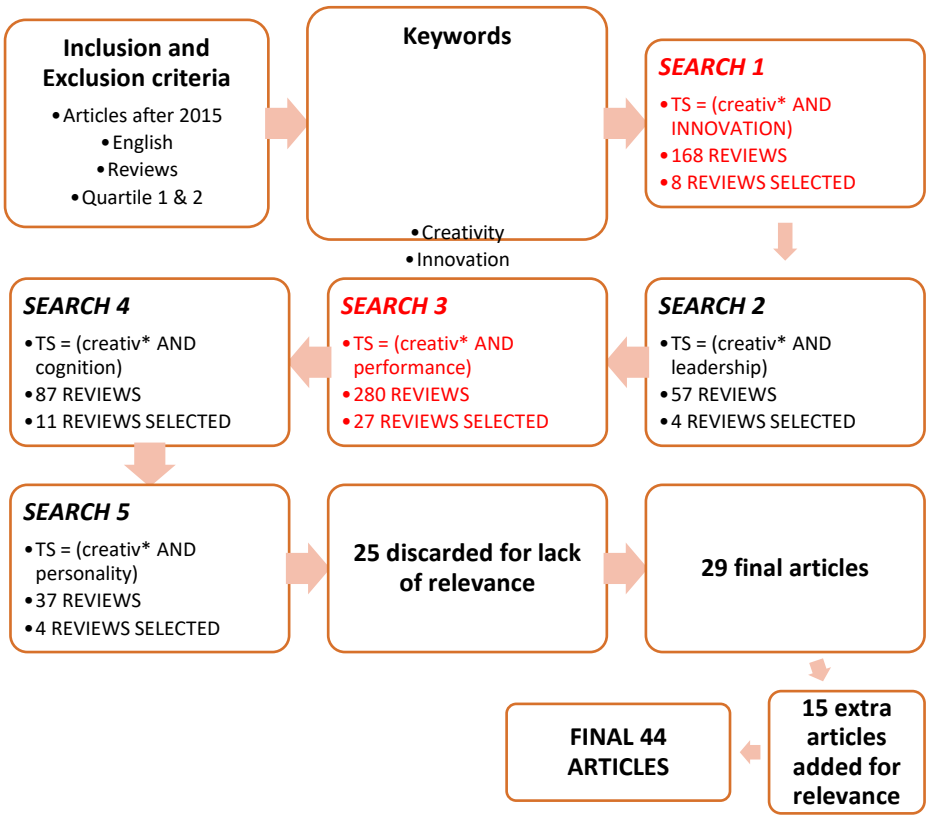
The third search included the keywords ‘creativity’ and ‘leadership:’ (TS=‘creativ* AND leadership’). This search provided 57 papers from the past five years and, like the first search, 4 papers were included for the final observation after the third and the fourth quartiles were excluded and those reviews that had no relevance to the definitions of creativity, innovation, or the variables affecting them.

The fourth search looked at ‘creativity’ and ‘cognition’ with keywords: (TS = ‘creativ* AND cognition’). The search supplied 87 reviews, 11 of which were selected for further observation after the initial filtering.

The final and fifth search ~~was~~ looked at ‘creativity’ and ‘personality’ as keywords: (TS = ‘creativ* AND personality’) which provided 37 reviews and 4 reviews after the initial filtering process.

Overall, all the initial searches have provided 55 reviews for further observation. After a closer look at the abstracts and text itself, 12 more reviews were discarded for the lack of relevance to the subject, however, they could perhaps be useful for further research into the creativity and innovation areas, but for the purpose of this systematic review, they were unhelpful. Finally, the total number of papers selected for the final version of the systematic literature review was 43. After thoroughly analyzing the 43 papers, another 17 articles were identified based on certain relevant topics studied in the reviews and added to the final count of

papers. All the studies were plugged into Mendeley software to get the basic information that included the title, authors, abstract, DOI, publication data, etc.



RESULTS

Creativity and innovation: same or different?

Across the literature, different definitions have been proposed for both creativity and innovation, especially in the organizational context. Before identifying the important factors that influence individual creativity, it is important to identify working definitions that all factors will rely upon. Even though both concepts are quite multifaceted and it is difficult to tease out the

most proper definition, it is important to create a consensus between the academic world, as well as the industry.

Amabile proposes a definition of creativity in one of the main models of creativity and innovation within the organizational context (Amabile 1988). The updated version of the componential model of creativity and innovation in organizations verifies the definition of the original model and says that creativity is the generation of novel and useful ideas and, without it, innovation cannot even exist because there would be nothing to implement (Amabile and Pratt 2016). Neuroscientific literature views creativity in the same way as was done in Amabile's model (Acar et al. 2019; Agarwal and Farndale 2017; Beaty et al. 2016; Boot et al. 2017; Ren, Yang, and Qiu 2019). Innovation, on the other hand, has been identified as the implementation of creative 'ideas, processes, products or procedures' that advance the aim of an organization (Acar et al. 2019; Amabile and Pratt 2016; Rubin and Abramson 2018). It is important to point out that innovation is synonymous with the implementation of creative ideas (Agarwal and Farndale 2017), even if certain academic works fail to mention creativity when talking about innovation or innovation when talking about creativity. According to Amabile's componential model, without creativity there cannot be innovation (Amabile and Pratt 2016). The generated creative idea or the end product of creativity – is a natural beginning of the process of innovation; therefore, the entire process of creativity together and its end result become the first step of the process of innovation (Amabile and Pratt 2016).

Apart from Amabile's theoretical framework, other research has proposed the idea of innovation being the 'implementation' of creative ideas while creativity is their 'generation', therefore, agreeing with the notion of creativity and innovation in Amabile's theoretical framework (Acar et al. 2019; Agarwal and Farndale 2017). Management literature points to the

fact that the generation and implementation of creative ideas are different concepts since many times generation does not lead to implementation and both constructs have the unique antecedents that influence them in different ways (Agarwal and Farndale 2017; van Knippenberg 2017). Apart from that, research points to the fact that a conceptual framework of implementation of creative ideas or its operationalization does not exist (Agarwal and Farndale 2017). Even though this goes against Amabile's model of creativity and innovation within an organizational context that includes a conceptual framework of innovation or 'creativity implementation,' it does point towards the lack of consensus with the differentiation of the two constructs, as well as a lack of empirical analysis for the frameworks that do exist.

Despite this, much research overlaps the notion of the generation of ideas and their implementation and calling it creativity, which goes against Amabile's framework and does not sequentially position innovation after creativity (Acar et al. 2019; Rubenstein, Callan, and Ridgley 2018).

Some research has gone in the opposite direction and has positioned innovation as both the generation of creative ideas, as well as their implementation with creativity just comprising the generation of novel and useful ideas, and, as a result, proposing the innovation as the overall process that encompasses creativity within it (Tang 2019). This academic literature does not define creativity and innovation separately but defines them together; within the same definition, however, the authors still specify that there are different stages of the process – one being the creativity with idea generation and the stage that follows the creativity stage – the implementation of the ideas (Tang 2019). Drawing conclusions from that, even the literature that proposes no differentiation of the constructs, ~~it~~ still defines creativity and innovation that

propose two different stages of generation and implementation of ideas, following Amabile's definition and framework.

Many neuroscientific advances mostly talk about the process of creativity and don't mention the implementation of creative ideas and studies show neuroimaging methods measuring the activation of brain areas when people engage in creative tasks (Beaty et al. 2015, 2016; Fox and Beaty 2019). The neurobiological literature mentions the involvement of different cognitive pathways throughout the process of creativity and separates the process of creativity itself into two stages – idea generation and idea self-evaluation before the creative idea is generated.

Even though brain networks and genetic underpinnings are a part of the discussion in this review, it does not point to the fact that creativity is necessarily an innate factor, nor is the ability to engage in innovative tasks. In fact, as with most behavior and cognitive functions, creativity has both a genetic and neural component, as well as an environmental component. This is regarded within Amabile's theoretical framework since she specifies that the processes of creativity, as well as innovation, are embedded within the organizational context, signifying an environmental component. Apart from that, other definitions of creativity highlight the importance of the social context in the process of creativity, with the end idea only possible to be judged by its utility if it is embedded within a social context (Rubenstein et al. 2018).

This review aims to understand the difference between the concepts of creativity and innovation and to differentiate the two constructs so that a consensus can be created within the body of academic literature. Amabile's theoretical framework on creativity and innovation within organizations and other literature supporting the notion of the differentiation between creativity and innovation – the generation of ideas and their further implementation – is the one

that gathers the majority of the support from the literature. Taking this into account, this review supports Amabile's framework that without the end product of creativity, innovation process cannot begin.

Since the academic body of literature has often ~~been~~ confused the concepts of creativity and innovation, many findings on the elements that affect them overlap so greatly that the knowledge coming from research has been previously looked at as "the same body of evidence." (van Knippenberg 2017:212) Taking this into account, the individual behavioral and cognitive factors that are presented in this review are relevant for both creativity and innovation processes, however, may affect the processes in different ways depending on which stage of the generation or the implementation the idea is in. Neurobiological research has mainly focused on creativity and not innovation and the findings coming from this body of literature support their effect on the process of creativity, while management literature has looked at both processes – regardless, all concepts can be related to both constructs. For this review, the whole process of generating creative ideas and then implementing them will be called the creative-innovative process.

Factors influencing individual creativity and creativity implementation (innovation)

According to the componential model (Amabile and Pratt 2016), and many other authors (Beaty et al. 2016; Khalil, Godde, and Karim 2019), various variables or 'components' influence the creative-innovative process. Amabile mentions domain expertise, motivation, and creativity-relevant skills but there have been many more results across the multidisciplinary approach taken to study the processes (Amabile and Pratt 2016). Amabile's model, based in the

organizational context, is a model that uses multidisciplinary knowledge in the sense that its sources come from a diversity of disciplines related either to psychology or management.

Neurobiology

Amabile's model mentions creativity-relevant skills including cognition and personality, and, according to neurobiological research, cognitive functions and behavioral elements are partially derived from general and neural predispositions, therefore, it is important to consider those to understand these cognitive factors. To start delineating the concepts of creativity and innovation from the innermost predispositions; the genetic and neural factors could help determine someone's 'baseline' level of creativity and innovation; if that baseline level of creativity and innovation truly does exist. Knowing the neural and genetic underpinnings of creative cognition could help understand whether creativity can be fostered and expanded or if one is given a certain level of creativity that stays with them throughout their entire life. This level of understanding could provide immense insight into the field of creativity and, subsequently, innovation. If creative skills and cognition cannot be improved throughout the years, it would be very easily determined whether one has a certain level of creative cognition needed for whichever type of task they hope to achieve.

Academics in the fields of neurobiology, genetics, and neuroscience have been pondering over the thought of creativity for many years now, trying to see exactly where in the genetic make-up and in the brain is creativity active and whether it can be manipulated. Whether the environment influences neurobiological and genetic predispositions in which creativity and innovation happen and whether both ~~the~~ constructs can be fostered has been debated for many

years in the field of neurobiology. The vast knowledge coming from neurobiological underpinnings hasn't been as widely discussed within the organizational literature (van Knippenberg 2017; Perry-Smith and Mannucci 2017). These studies have made considerable progress in recent years and now research has shown certain brain activations whenever people and other non-human animals engage in what are deemed creative tasks. Some of these studies, however, do rely on measurements, tests and scales of creativity that are not universally considered to measure creative cognition, therefore, one must always take the information with caution, realizing that there hasn't been a worldwide accepted method of measuring creativity up to this date.

Despite that, as was explained before, certain works of creative cognition are easier to measure compared to others because they do produce highly novel and useful products for a wider audience (e.g. artistic performance or scientific innovation). Taking that into account, one can look at activations in brain areas throughout these tasks. According to ~~the~~ literature, overtime and across various 'creative' tasks a seemingly consistent pattern of activation that results in ~~a~~ functional connectivity between two specific networks within the brain has been observed (Beaty et al. 2016; Beaty, Seli, and Schacter 2019; Chrysikou 2019; Jung and Chohan 2019). These networks are the Default Mode Network (DMN) and the Executive Control Network (ECN). The functional connectivity between the two networks might seem surprising to someone who studies neuroscience due to their differing functions, but becomes all the more interesting once the creativity and the idea generation concepts are brought into it.

DMN is "a set of midline and posterior inferior parietal brain regions" (Beaty et al. 2019) and is activated when engaging in self-referential thought processes and mind-wandering. The network activates when there appear~~s~~ to be no external stimuli or a cognitively stimulating task

that activates other areas and networks in the brain. It is much more associated with spontaneity, self-generated thoughts; thinking about the future, and retrieval of episodic memory (Beaty et al. 2016). Interestingly enough, certain activities that can be undertaken do appear to activate the DMN, them being social cognition; meditation; mindfulness exercises, and, hallucinogenic drugs (Baas et al. 2016; Berkovich-Ohana et al. 2012; Jang et al. 2011; Jones, Blagrove, and Parrott 2009; Palhano-Fontes et al. 2015; Sweat, Bates, and Hendricks 2016; Zabelina, Condon, and Beeman 2014).

The ECN is a network made up of 'lateral prefrontal and anterior inferior parietal regions' (Beaty et al. 2016). In comparison with the DMN, it activates when engaging in cognitive processes that require focused control and attention; maintaining goals, working memory, task switching, etc. (Beaty et al. 2016, 2019; Jung and Chohan 2019). During creative cognition, one specifically important aspect associated with the activity of the ECN has been discovered. When engaging in creative tasks, the ECN works hard to retrieve memories in a goal-directed way; meaning that one should purposefully search the memory stores for the information that is related to the task at hand (Beaty et al. 2019). The memories being searched have been proposed to be episodic and semantic memories (Beaty et al. 2019). Moreover, the retrieval of memories in a goal-directed way is not the only function that the ECN employs; other studies have noticed that other cognitive control functions are present. 'Prepotent-response inhibition' (Beaty et al. 2019) appears to be a control function that is directed by the ECN, which helps subdue the intrusion of already simple and present reaction predispositions and ideas that do not take effort from appearing. That could be an essential concept in creative cognition because one needs to be able to reach the information that is not easily accessible or even create

something that does not exist to generate something truly ‘novel’ and ‘useful’ so it can be called creative.

The functional connectivity that occurs during a creative task between the ECN and the DMN has been a surprising discovery due to the polar opposite functions that the two networks are responsible for (Beaty et al. 2016, 2019; Jung and Chohan 2019). According to recent findings, during a creative cognitive task, the two networks play hand in hand, depending on which stage of the creative-innovative process the mind is being engaged in. Both, the top-down (control) and bottom-up (imaginative) actions occur throughout creative cognition. Research and brain imaging studies show that people who are acknowledged for their creative and innovative skills; can switch back and forth between the two patterns of brain connectivity (Beaty et al. 2019).

The presence of two distinct brain networks led researchers to believe that there are two steps in the process of creative cognition (Beaty et al. 2016). According to recent research, the two-step process involves the level of idea generation and idea evaluation (Beaty et al. 2016). The literature says that the idea generation process or the first step in the creativity part of the creative-innovative process activates the DMN network due to the need for the use of bottom-up processing, mind-wandering, and ‘internally focused attention’ (Beaty et al. 2019). The ECN is responsible for the second part and the idea evaluation with ‘focused attention and cognitive control’ (Beaty et al. 2016). This could correspond to subsequent factors that influence the generation of creative ideas and the predictors for their further implementation, corresponding to the process of creativity proposed in Amabile’s theoretical framework. Apart from the DMN and ECN, the salience network activates as well and ~~which~~ is responsible for searching for the stimuli in the outside world that are relevant to bring to attention ~~activates as well~~ (Beaty et al.

2016). As will be discussed further, attention, as well as memory are some of those cognitive constructs that appear essential in the generation and further evaluation of ideas, which brings forward the idea of the cooperation between the two main network hubs – DMN and ECN.

This functional connectivity could be further explained with regard to specific tasks; it is not surprising that parts of the brain responsible for executive control would need to be activated during creative activities that require meeting specific goals. Despite that, to generate novel ideas, the DMN must still play a part, activating when one should internally think and derive attention inwards. Taking this into account, this cooperation between the two networks makes sense, as well as potentially provides some beneficial strategies for engaging in creative tasks. Perhaps, drawing from conclusions of ~~the~~ brain connectivity, one could assume that if the creative activity has a specific goal that needs to be met; an individual would be more likely to generate novel and useful ideas due to this cooperation between the DMN and ECN. This could provide fruitful suggestions for future research. Indeed, very interesting research has been done trying to directly affect these network areas in the brain to see whether that would enhance creativity via the use of Transcranial Direct Current Stimulation (tDCS); it is a technique that allows regulating the excitability in the brain. According to the literature done on tDCS; there is a belief that by modulating the abovementioned areas, specifically, the DMN network; the brain will enter a creativity/on state, which could promote an individual to go beyond simple associations and engage in mind-wandering and creative thought processes (Lucchiari, Sala, and Vanutelli 2018). There has been some evidence of the differences in this functional connectivity between sexes, with studies supporting different levels of activations between men and women (Beaty et al. 2019). There has not been much research done on this particular topic, however, it is

important to remember that there do exist differences between genders when talking about creative cognition and potential; a topic very relevant to the organizational world.

Apart from differences in the activation of different brain networks, there has also been research done into neural and genetic underpinnings associated with creative cognition and potential. Creative potential refers to the predisposition of someone to generate novel and useful ideas (Ren et al. 2019). According to research, certain genes that are involved in dopamine (DA) transmission 'such as catechol-*O*-methyltransferase gene (COMT) and the dopamine D2 receptor gene (DRD2)' (Ren et al. 2019) could also be involved in individual creative potential. Apart from dopamine, other neuromodulator pathways play a role in creative cognition, norepinephrine appears to have a link with novelty, while serotonin with behavioral inhibition, which could help engage in creative tasks (Gu et al. 2018; Khalil, Godde, and Karim 2019). Apart from these neural and genetic underpinnings, alpha-band activity is important in the creative-innovative process because it generates solutions to different problems with certain inward awareness, and the activation of the alpha-band could be understood as internally-driven attention observed with the activity of the DMN network.

Knowledge of neural and genetic underpinnings provides an opening to discuss cognitive and behavioral elements of creativity, as well as helps with the differentiation between creativity and innovation; since state-of-the-art neuroimaging methods are able to see the activation of different neuronal networks throughout each step of the process.

Cognition

A component of Amabile's framework is creativity-relevant skills, which are described as cognitive and behavioral components relevant to the process of creativity. As mentioned

beforehand, the underlying neural and brain mechanisms are predispositions to certain cognitive outcomes that could be visible in individuals and could be considered markers of creative cognition or creative potential. Various cognitive markers have been recognized to be important in the individual creative-innovative process and more and more continue to be discovered. There is an opportunity for potential research ~~here~~ because up to this date not everything is known about cognitive and-behavioral constructs that underlie individual creative cognition. In fact, management literature points towards cognitive and motivational processes acting as "underlying mechanisms" affecting creativity and innovation processes (Acar et al. 2019:97).

As mentioned before, the brain areas important for the generation and evaluation of creative ideas are the DMN, ECN, and the salience networks (Marron and Faust 2019). The majority of the cognitive constructs important for creative-innovative processes come from the functions that correspond to these networks. These cognitive components are relevant to the processes of creativity and derived from neuroscientific findings, but can be embedded within the organizational context.

Cognitive flexibility

One of the most important cognitive constructs is the 'internally-oriented cognition' and 'internally-oriented attention' that are the markers of the DMN and the salience network activity (Zabelina and Andrews-Hanna 2016). Mind-wandering, which occurs during the activation of the DMN networks, has been associated with creativity due to the existence of flexibility in the thought pattern process, which could help in the generation of creative ideas (Boot et al. 2017; Chrysikou 2019; Khalil et al. 2019; Zabelina and Andrews-Hanna 2016). Indeed, this flexibility in the thought process is seen in the first stage of the creative-innovative process which complements the concept of the DMN activating in the first stage of the creative-innovative

process (Chrysikou 2019; Di Domenico and Ryan 2017; Jia, Li, and Cao 2019; Lucchiari et al. 2018; Rubenstein, Callan, and Ridgley 2018; Zabelina and Andrews-Hanna 2016). This flexibility and internally-directed thought process pattern is related to the fast processes that help extract information from episodic and semantic memory (Marron and Faust 2019).

Persistence

Apart from these spontaneous processes and internally driven thought processes, executive and cognitive control play a big part in creative cognition, as the emergence of the ECN brain hub network in the creative-innovative process shows. Consistently with the two-step approach to the creative-innovative process or the 'dual pathway' of creativity, there appears to be different cognitive constructs that respond to different behaviors within this creative-innovative process. On one side there is flexibility and on the other side, researchers believe in the existence of the 'persistence' pathway (Boot et al. 2017; Di Domenico and Ryan 2017; Jia et al. 2019; Khalil et al. 2019; Rubenstein et al. 2018; Wang and Nickerson 2017). Researchers believe that not only spontaneous processes lead to the emergence of novel and useful ideas, however, hard work and dedication or 'persistence', which involves methodical, organized, precise, and purposeful investigation of creative prospects, can lead to the generation of creative ideas as well (Boot et al. 2017; Khalil et al. 2019). Combining the concept of hard work, effort, and dedication with the concept of intrinsic motivation where individuals engage in internally pleasurable and satisfying activities to the creation of new and useful ideas could be very interesting and beneficial to research in the field of creative cognition.

Emotional context

A relationship between the creative-innovative process and the emotions evoked by the task in hand exists (Beaty et al. 2016; Chrysikou 2019; Gu et al. 2018; Jia et al. 2019; Khalil et al. 2019; Stevens and Zabelina 2019; Zabelina and Andrews-Hanna 2016). Research has focused on developing and characterizing the relationship between creativity and emotion; in fact, many psychopathologies that involve affective and mood disorders are associated with high levels of creativity (Gu et al. 2018). Some work has been done to understand this particular relationship and various clues have been brought forward showing that emotional context can affect creativity and engaging in creative tasks can even help temper negative emotions (Gu et al. 2018). In fact, certain neuromodulators, including dopamine, neuropenephrine, and serotonin affect both creativity and emotion (Boot et al. 2017; Gu et al. 2018). Even though, much academic work has attempted to depict the association, to this day the exact mechanism or mechanisms through which emotion can affect creativity and vice versa is still unknown due to the complexity of both concepts. This could provide an advantageous area of research.

Motivation

Closely related to emotion and something that has been noted in creativity research over many disciplines is motivation. Specifically, intrinsic motivation plays a key role in the pre-requisite for generating creative ideas (Boot et al. 2017; Di Domenico and Ryan 2017; Gu et al. 2018; Jia et al. 2019; Khalil et al. 2019; Lucchiari et al. 2018; Rubenstein et al. 2018; Silvia 2015; Wang and Nickerson 2017). Intrinsic motivation is one's inclination to search for originality and obstacles and to increase and train one's own competency in any activity; as well as to inspect novel things and to acquire new information (Di Domenico and Ryan 2017). Being intrinsically motivated in a task or in a certain activity means seeking out ways to challenge yourself and improve yourself without external influence, but only out of your own will. When

participating in a certain activity, those who are intrinsically motivated will find the task extremely thought-provoking and absorbing and will experience an overall sense of enjoyment and fulfillment from engaging in the task (Di Domenico and Ryan 2017; Khalil et al. 2019).

Scientists identify a different type of motivation, which is extrinsic and is driven by external advantages and beneficial results that will be achieved because of participating in the task (Di Domenico and Ryan 2017). The creative-innovative process has been specifically associated with intrinsic motivation where people participate in a creative task due to their own wishes and desires vs. beneficial consequences. Motivational processes signify the willingness of some to participate in tasks that are associated with creativity and innovation (Acar et al. 2019). Apart from creativity, intrinsic motivation has been related to better performance, enriched learning experiences, and positive emotional experiences (Di Domenico and Ryan 2017; Khalil et al. 2019), which are critical in the context of work-related behavior. Intrinsic motivation appears to have better empirical behavioral measures than creativity or innovation; therefore, it could be an interesting pursuit of research trying to find a specific link between motivation and creativity. Intrinsic motivation involves similar neuromodulators as creativity (dopamine), as well as ~~a~~ similar functional connectivity between the DMN, ECN, and the salience network hubs, in a similar fashion as the creative-innovative process (Di Domenico and Ryan 2017; Gu et al. 2018; Khalil et al. 2019).

Attention

The persistence pathway is associated with external attentional work (Boot et al. 2017). Attention is one of the cognitive constructs important both for the spontaneous and flexible processing when individuals direct their attention inwards, as well as external attention when individuals apply attention to the task in hand with a purpose (Amer, Campbell, and Hasher

2016; Beaty et al. 2016, 2019; Benedek and Fink 2019; Boot et al. 2017; Chrysikou 2019; Di Domenico and Ryan 2017; Gu et al. 2018; Heilman 2016; Jia et al. 2019; Jung and Chohan 2019; Khalil et al. 2019; Lucchiari et al. 2018; Marron and Faust 2019; Rubenstein et al. 2018; Stevens and Zabelina 2019; Wang and Nickerson 2017; Zabelina and Andrews-Hanna 2016). Decreased cognitive control can be associated with a reduction in the ability to remove those stimuli and information that are unnecessary for the given task, which, in the context, of companies and organizations could be destructive (Amer et al. 2016). The research on attention has been wide and has touched upon various constructs within the attentional focus.

According to certain studies, the wider attentional focus is relevant to people who are more creative because it allows them to think about more information simultaneously, which permits ~~for~~ more cognitive flexibility (Amer et al. 2016; Benedek and Fink 2019; Boot et al. 2017; Chrysikou 2019; Lucchiari et al. 2018). Attention is essential during creative implementation. This is because individuals should ensure they focus on the information that is specific to the activity at hand, which is related to the part of the creative-innovative process that is cognitively controlled and deliberate (Amer et al. 2016; Beaty et al. 2019; Chrysikou 2019; Di Domenico and Ryan 2017; Gu et al. 2018; Rubenstein et al. 2018). This is related to the second stage of the creative-innovative process and the activation of the ECN network hub (Beaty et al., 2019). Purposeful focusing on the relevant information filters all that is unnecessary for the task. According to the literature, attention can be driven by the novelty of different stimuli, as well as emotional stimuli (Gu et al. 2018). Internally focused attention is also an important aspect of the creative-innovative process, shown by the activity of the DMN network, dopaminergic activity, and the alpha-band activities that have all been found to be prevalent during the process (Beaty et al. 2019; Jung and Chohan 2019; Khalil et al. 2019; Lucchiari et al. 2018; Marron and Faust

2019; Stevens and Zabelina 2019; Zabelina and Andrews-Hanna 2016). Despite these findings, the concept of attention in relation to creativity and innovation is quite broad and does not provide similar results across studies due to both concepts being quite complex by themselves (Benedek and Fink 2019).

Intelligence

Over the years researchers have debated the existence and intricacies of the relationship between intelligence, creativity, and innovation (Amer et al. 2016; Benedek and Fink 2019; Boot et al. 2017; Gu et al. 2018; Heilman 2016; Jia et al. 2019; Jung and Chohan 2019; Khalil et al. 2019; Rubenstein et al. 2018; Silvia 2015). Do people need to have a certain level of intelligence to be creative? If that is, indeed the case, researchers then ask whether intelligence needs to be general or, perhaps, the level of intelligence and knowledge that the individual possesses needs to be specific to the activity that is presented to them. According to some researchers, intelligence or, specifically fluid intelligence has an association with creativity (Khalil et al. 2019; Silvia 2015). Fluid intelligence is the subtract of general intelligence that is associated with the ability of individuals to create solutions to problems and think logically regardless of the level of knowledge that they have acquired previously in the given domain; it is related to rational thinking and executive control (Silvia 2015).

Memory

Closely related to intelligence and mentioned in various literature are the different types of memories and, specifically, the retrieval of certain information from memory (Aldave et al. 2019; Amer et al. 2016; Beaty et al. 2016, 2019; Benedek and Fink 2019; Boot et al. 2017; Chrysikou 2019; Di Domenico and Ryan 2017; Heilman 2016; Jia et al. 2019; Jung and Chohan

2019; Khalil et al. 2019; Lucchiari et al. 2018; Marron and Faust 2019; Rubenstein et al. 2018; Silvia 2015; Stevens and Zabelina 2019; Wang and Nickerson 2017; Zabelina and Andrews-Hanna 2016). Memory is important for both the initial stage of the creative-innovative process where associations happen spontaneously, as well as the deliberate search for further extraction of task-required information (Silvia 2015). Memory is a very interesting concept because creativity involves generating novel ideas, therefore, by definition, it involves creating something new and not using memory. Despite this, novel and useful ideas do not come out of thin air, however, are a result of modifications of information that is already present, specifically of items that are less associated with one another (Benedek and Fink 2019). Working memory capacity; is specifically closely related to creative cognition because, during a purposeful search for information, working memory is the one that is employed (Amer et al. 2016; Boot et al. 2017; Khalil et al. 2019). According to some studies, the decrease in cognitive control that could be shown by the capacity of the working memory could lead to more creative problem-solving, as well as learning (Amer et al. 2016). This could perhaps be beneficial with the first stage of the creative-innovative process where internally driven attention, as well as reduced cognitive control is needed; however, for the evaluation stage, increased cognitive control seems to be more beneficial. Research says that higher cognitive control and, specifically, the quantity of information that can be kept within working memory, which signifies working memory capacity is highly related to directed focus and restriction of unrelated components (Amer et al. 2016). The knowledge of the importance of working memory for the creative-innovative process could be especially beneficial for assigning certain individuals to different types of tasks that require contrasting sets of capacities. Tests for working memory abilities and capacity could help

organizations solve these problems more efficiently and this could lead to a worthwhile line of research.

Learning

It is not surprising that learning has been associated with creative cognition in the literature (Acar et al. 2019; Amer et al. 2016; Boot et al. 2017; Di Domenico and Ryan 2017; Heilman 2016; Jia et al. 2019; Khalil et al. 2019; Rubenstein et al. 2018; Silvia 2015; Wang and Nickerson 2017). According to research, different individuals with different levels of creative mental make-ups vary in the way they use distinct cognitive processes, learning included (Jia et al. 2019). The stages of the learning process fit in very well with the creative-innovative process (Rubenstein et al. 2018). In fact, some literature suggests that the concept of cognitive knowledge is an integral part of the creative-innovative process (Jia et al. 2019). As mentioned before, decreased cognitive control may help in creative problem-solving; similar outcomes occur with the learning process by aiding in recognizing different probabilistic sequences of information, especially when it overtaxes the scope of the working memory (Amer et al. 2016). Indeed, certain neuromodulator biomarkers are similar to those that have been recognized for the creative-innovative process – with a paramount release of dopamine during the learning process (Boot et al. 2017; Gu et al. 2018).

Intrinsic motivation, which has been noted before as an important concept for the creative-innovative process, appears very prominent in the learning process as well (Di Domenico and Ryan 2017). In fact, people tend to engage in self-directed learning when they feel curious about something – that is; when they feel that they do not know as much as they want to know, and they seek to learn something out of their own will, therefore, guided by intrinsic motivation (Di Domenico and Ryan 2017). If a person is genuinely interested in the

activity that they are engaging in and they must generate an idea that is useful , they might deliberately and with purpose attempt to learn more about this activity, therefore, engaging in learning and ~~a~~ creative-innovative process simultaneously.

Indeed, certain researchers have put the creative-innovative process strategies within the framework of self-regulated learning, which is a system of processes that involves utilizing planning procedures, putting goals into motion, and meta-cognition, where one engages in 'thinking about one's thinking' (Jia et al. 2019; Rubenstein et al. 2018). This framework involves three stages that involve similar processes and constructs to the creative-innovative process, such as the planning and setting of goals, which needs intrinsic motivation; the actual generation of the task in hand or the performance stage; and further evaluation of the outcome which involves a lot of meta-cognition (Rubenstein et al. 2018). The self-evaluation phase is crucial, it returns to the original two-stage process of creative cognition with the cognitive control network hubs being responsible for evaluating the generated idea. This particular relationship between learning and creativity is essential for people's everyday lives ~~but~~, especially, within organizations and companies that strive for creativity and innovation. The framework gives hope that creativity is not just a predisposition that certain people might be born with; however, that creativity can be learned and fostered. The relationship between creativity and learning should be further explored, especially since the research on creativity could, perhaps, also benefit from the measurement techniques used to assess learning (Rubenstein et al. 2018).

All of the aforementioned cognitive components are relevant to creativity, as well as innovation, and fit within Amabile's theoretical framework components of the process of creativity and innovation. Amabile's theoretical framework is dynamic and proposes that both creativity and innovation processes move through stages and the end product of creativity is the

creative generated idea that is a predisposition for the beginning of the innovation process. Considering this, it is important to mention these cognitive and behavioral elements and their relevance and relationship with creativity to open a door for future differentiation through the dynamic stages of the creative process and then the innovative process since these elements have different degrees of relevance depending on the stage of the process. Table 1 presents all the individual cognitive constructs identified as the result of this systematic literature review.

Table 1. Cognitive constructs related to individual creative-innovative process

Cognitive constructs related to individual creative-innovative process	*Evidence*	*Separation of creativity and innovation*
Flexible flow of thoughts; cognitive flexibility	• (Zabelina & Andrews-Hanna, 2016)(Zabelina & Andrews-Hanna, 2016); • (Boot et al., 2017)(Boot et al., 2017) • (Khalil et al., 2019)(Khalil et al., 2019) • (Chrysikou, 2019)(Chrysikou, 2019) • (Rubenstein et al., 2018)(Rubenstein et al., 2018)	Cognitive flexibility seems to be much more present during the generation of creative ideas - creativity part of the creative-innovative process where the engagement of mind-wandering and open flow of thoughts is much more necessary.

	• (Lucchiari et al., 2018)(Lucchiari et al., 2018) • (Chrysikou, 2019)(Chrysikou, 2019) • (Di Domenico & Ryan, 2017)(Di Domenico & Ryan, 2017) • (Jia et al., 2019)(Jia et al., 2019)	
Emotional context	• (Zabelina & Andrews-Hanna, 2016)(Zabelina & Andrews-Hanna, 2016); • (Gu et al., 2018)(Gu et al., 2018) • (Beaty et al., 2016b)(Beaty et al., 2016b) • (Stevens & Zabelina, 2019)(Stevens & Zabelina, 2019) • (Chrysikou, 2019)(Chrysikou, 2019) • (Khalil et al., 2019)(Khalil et al., 2019)	Emotions have been found important for the process of creativity, especially from a neurobiological point of view – with many neuromodulators responsible for emotional responses in humans also influencing creativity. Emotional context does not bring evidence into the separation of creativity and innovation construct, however, proves important to be researched further.

	• (Jia et al., 2019)(Jia et al., 2019)	
Motivation	• (Di Domenico & Ryan, 2017)(Di Domenico & Ryan, 2017) • (Rubenstein et al., 2018)(Rubenstein et al., 2018) • (Boot et al., 2017)(Boot et al., 2017) • (Lucchiari et al., 2018)(Lucchiari et al., 2018) • (Wang & Nickerson, 2017)(Wang & Nickerson, 2017) • (Silvia, 2015)(Silvia, 2015) • (Khalil et al., 2019)(Khalil et al., 2019) • (Gu et al., 2018)(Gu et al., 2018) • (Jia et al., 2019)(Jia et al., 2019)	Motivation is a construct that is important throughout both processes – creativity and innovation. Despite that, research points to motivation's influence for people to engage in creative projects in the first place – pre-requiste for generation of creative ideas. So while the construct itself doesn't specify the separation between creativity and innovation, it does aid in understanding that the generation of ideas comes before their implementation.
Persistence	• (Khalil et al., 2019)(Khalil et al., 2019)	Persistence is a cognitive function that is important

	• (Di Domenico & Ryan, 2017)(Di Domenico & Ryan, 2017) • (Rubenstein et al., 2018)(Rubenstein et al., 2018) • (Boot et al., 2017)(Boot et al., 2017) • (Wang & Nickerson, 2017)(Wang & Nickerson, 2017) • (Jia et al., 2019)(Jia et al., 2019)	both for generating creative ideas and in the further stages of the process. While it is important to be flexible during the generation of creative ideas, too much flexibility can also be harmful in a way that it doesn't allow a human to commit to one idea and later on implement it. Research on persistence places generation of creative ideas first and then their implementation, with both creativity and innovation benefitting from the persistence pathway.
Intelligence *fluid intelligence	• (Jung & Chohan, 2019)(Jung & Chohan, 2019) • (Silvia, 2015)(Silvia, 2015) • (Boot et al., 2017)(Boot et al., 2017) • (Khalil et al., 2019)(Khalil et	Fluid intelligence shows association with the flexible flow of thoughts and cognitive flexibility, therefore, important for generation of creative ideas.

	al., 2019) • (Rubenstein et al., 2018)(Rubenstein et al., 2018) • (Amer et al., 2016b)(Amer et al., 2016b) • (Gu et al., 2018)(Gu et al., 2018) • (Jia et al., 2019)(Jia et al., 2019) • (Benedek & Fink, 2019)(Benedek & Fink, 2019) • (Heilman, 2016)(Heilman, 2016)	There needs to be more research done on the importance of intelligence for innovation process.
Attention	• (Boot et al., 2017)(Boot et al., 2017) • (Amer et al., 2016b)(Amer et al., 2016b) • (Benedek & Fink, 2019)(Benedek & Fink, 2019) • (Rubenstein et al., 2018)(Rubenstein et al., 2018) • (Beaty et al., 2016b)(Beaty et al., 2016b)	Attention is essential during both creative generation and implementation. It shows a clear separation between creativity and innovation because in the first one attention is directed inwards to allow for flexible processing of information and in the second one –

	• (Lucchiari et al., 2018)(Lucchiari et al., 2018) • (Stevens & Zabelina, 2019)(Stevens & Zabelina, 2019) • (Chrysikou, 2019)(Chrysikou, 2019) • (Wang & Nickerson, 2017)(Wang & Nickerson, 2017) • (Zabelina & Andrews-Hanna, 2016)(Zabelina & Andrews-Hanna, 2016) • (Di Domenico & Ryan, 2017)(Di Domenico & Ryan, 2017) • (Khalil et al., 2019)(Khalil et al., 2019) • (Marron & Faust, 2019)(Marron & Faust, 2019) • (Beaty et al., 2019)(Beaty et al., 2019) • (Gu et al., 2018)(Gu et al.,	externally when individuals apply attention to the task in hand with a purpose in a cognitively controlled and deliberate way.

	2018) • (Jia et al., 2019)(Jia et al., 2019) • (Jung & Chohan, 2019)(Jung & Chohan, 2019) • (Heilman, 2016)(Heilman, 2016)	
Memory * Fast retrieval of information from episodic and semantic memory	• (Boot et al., 2017)(Boot et al., 2017) • (Wang & Nickerson, 2017)(Wang & Nickerson, 2017) • (Zabelina & Andrews-Hanna, 2016)(Zabelina & Andrews-Hanna, 2016) • (Amer et al., 2016b)(Amer et al., 2016b) • (Beaty et al., 2019)(Beaty et al., 2019) • (Marron & Faus(Stevens & Zabelina, 2019)(Marron & Faus(Stevens & Zabelina, 2019)19)19)	Memory is important for both the initial stage of the creative-innovative process where associations happen spontaneously, as well as the deliberate search for further extraction of task-required information when implementation of the creative idea happens

	• (Stevens & Zabelina, 2019)(Stevens & Zabelina, 2019) • (Rubenstein et al., 2018)(Rubenstein et al., 2018) • (Lucchiari et al., 2018)(Lucchiari et al., 2018) • (Khalil et al., 2019)(Khalil et al., 2019) • (Di Domenico & Ryan, 2017)(Di Domenico & Ryan, 2017) • (Silvia, 2015)(Silvia, 2015) • (Beaty et al., 2016b)(Beaty et al., 2016b) • (Jia et al., 2019)(Jia et al., 2019) • (Jung & Chohan, 2019)(Jung & Chohan, 2019) • (Benedek & Fink, 2019)(Benedek & Fink, 2019) • (Heilman, 2016)(Heilman, 2016)	

Learning	• (Rubenstein et al., 2018)(Rubenstein et al., 2018) • (Amer et al., 2016b)(Amer et al., 2016b) • (Boot et al., 2017)(Boot et al., 2017) • (Wang & Nickerson, 2017)(Wang & Nickerson, 2017) • (Di Domenico & Ryan, 2017)(Di Domenico & Ryan, 2017) • (Silvia, 2015)(Silvia, 2015) • (Khalil et al., 2019)(Khalil et al., 2019) • (Gu et al., 2018)(Gu et al., 2018) • (Jia et al., 2019)(Jia et al., 2019) • (Heilman, 2016)(Heilman, 2016)	The stages of the learning process fit with the creative-innovative process. The concept of cognitive knowledge is an integral part of the creative-innovative process. This construct isn't clear about the separation between creativity and innovation and more research needs to be done in order to delineate the importance of learning between generation and implementation of creative ideas.

Personality

Apart from the various cognitive constructs discussed above and that are associated with the creative-innovative process; certain individual traits have been found in the literature to also have a relationship with the creative-innovative process and, especially, with the creative potential. Certain personality traits associate with the willingness to engage in the creative-innovative process in the first place and, could be considered as predispositions for better success in the generation of novel and useful ideas and their further implementation (Feist 2019; Puryear, Kettler, and Rinn 2017). Amabile's framework mentions the individual traits and, specifically, personality traits as relevant to the organizational context and the process of creativity and innovation within the creativity-relevant traits component of her model (Amabile and Pratt 2016). The importance of personality traits has been prominent in the organizational context and is relevant to understanding creativity and innovation (Amabile and Pratt 2016).

The field of personality psychology has been consistent with the categorization of personality traits; the Big Five Model or the Five Factor Model of personality has ruled over the world of personality psychology for many years now (Feist 2019). The Big Five Model talks about five different aspects of personality, these aspects are Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (or emotional stability) (Feist 2019; Jung and Chohan 2019; Puryear et al. 2017). Recently, researchers have re-thought the concept of the Big Five Model of personality and nowadays scholars tend to lean towards the Big Two model of personality that divides the previously named elements of the Big Five into Plasticity and Stability (Feist 2019). To understand the two models; it is important to delineate the individual concepts one by one.

Openness to experience refers to the general inclination of someone to novelty in challenges, opportunities, and concepts; as well as a high level of cognitive flexibility (Beaty et al. 2019; Feist 2019; Heilman 2016; Jung and Chohan 2019; Puryear et al. 2017; Ren et al. 2019; Rubenstein et al. 2018). Conscientiousness is a tendency of an individual to be responsible for the goals that they put in front of themselves, as well as the level of their dependability (Feist 2019; Puryear et al. 2017). Conscientiousness must do with the level of control that people have over their desires and themselves in general (Feist 2019; Puryear et al. 2017). Extraversion is an inclination to find pleasure in social interactions; search for exciting experiences; have leader-like capabilities (Feist 2019; Puryear et al. 2017). Agreeableness is the tendency for compassion, empathy, and warmth, especially when interacting with others; those high in agreeableness tend to have a more collective outlook on the world compared to an individual one. Finally, neuroticism is characterized by a reduction in ~~the~~ emotional stability and people high in neuroticism are generally nervous and anxious and tend to be more prone to negative emotions. If one chooses to call this trait emotional stability; then people who are high in emotional stability have a calm nature, and positive affect because emotional stability is located on the other side of the continuum from neuroticism (Feist 2019; Puryear et al. 2017).

Those who tend to follow the Big Two model of personality have noticed that the five aspects of the Big Five model overlap with one another. Indeed, according to the literature, high levels of emotional stability, agreeableness, and conscientiousness appear to form a network, while high levels of extraversion and openness to experience form another network hub (Feist 2019). Emotional stability, agreeableness, and conscientiousness, therefore, make up the Stability facet of the Big Two, while extraversion and openness to experience make up the other (Feist 2019). Stability refers to those behavioral tendencies that help individuals in stressful

situations, adverse affect, compliance to social rules, as well as the overall feeling of compassion, warmth, and empathy in communicating with others and having a personal level of control (Feist 2019). In contrast, Plasticity refers to cognitive flexibility; enjoyment of social interaction, curiosity towards new experiences and challenges throughout life, as well as not obeying to social rules without question and encountering positive affect (Feist 2019).

Many studies have reported the association of openness to experience, specifically, as a pre-requisite for engaging in the creative-innovative process (Beaty et al. 2019; Boot et al. 2017; Chrysikou 2019; Di Domenico and Ryan 2017; Feist 2019; Gu et al. 2018; Jung and Chohan 2019; Khalil et al. 2019; Lucchiari et al. 2018; Puryear et al. 2017; Ren et al. 2019; Rubenstein et al. 2018; Silvia 2015).

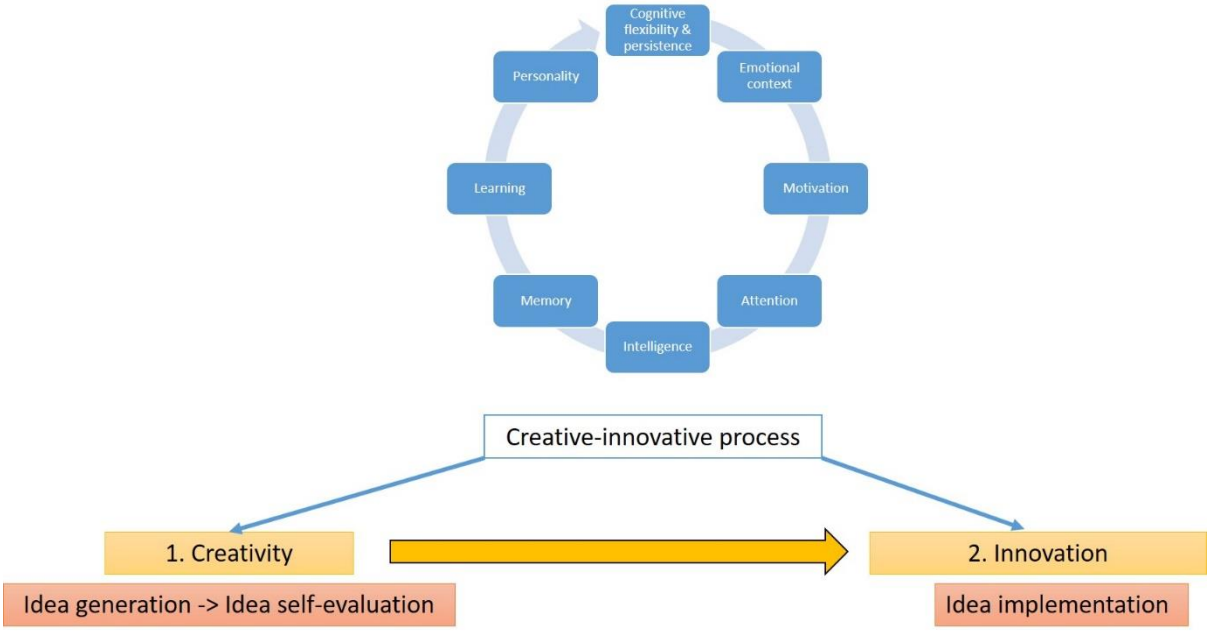
Extraversion closely follows after openness to experience in terms of its association with creative potential and high levels of agreeableness and neuroticism appeared to actually hinder the creative-innovative process (Puryear et al. 2017). From the Big Two Model of Personality, plasticity is more associated with the creative-innovative process in comparison with stability (Feist 2019). Plasticity is composed of openness to experience and extraversion, the factors that are more associated with the creative-innovative process (Puryear et al. 2017). Across literature, it seems clear that those personality traits that are associated with curiosity and seeking new experiences, and confidence and seeking exciting opportunities, are more associated with creative cognition. When looking at the relationship between the other three variables, agreeableness, conscientiousness, and neuroticism, the findings are not as clear and appear somewhat inconclusive (Feist 2019). Specifically, some studies have found that a low score on the agreeableness scale promotes creative thought when the environment around the individual is against novelty and new experiences, while other studies find a very low association with the

agreeableness facet in general (Feist 2019). Similar discrepancies have been found in the studies investigating the relationship between conscientiousness and creativity, and neuroticism and creativity (Feist 2019).

Certain biological underpinnings support the findings described above with the DMN effectiveness being positively associated with the openness to experience personality traits; in fact, this research showed that the more capable the default mode was, the higher the participants scored on the openness to experience (Feist 2019). More research should be done regarding the other facets of personality traits. According to the definitions put forward, it would be interesting to see whether agreeableness and conscientiousness would be more positively associated with the second stage of the creative-innovative process – the evaluative one – because it involves some cognitive control, responsibility, goal-directedness, focused attention, etc. This could provide a very interesting line of research, especially if one were to consider the activation of the ECN network hub and its association with those particular personality traits.

DISCUSSION

Figure 1. Creative-innovative process



The first purpose of this review was to understand the conceptualization of creativity and innovation separately so by reviewing the major theories surrounding the constructs, it has placed creativity as the predecessor of innovation (Fig. 1). This paper has reviewed the literature regarding creativity and innovation constructs. While some of the literature has shown discrepancy in the understanding of creativity and innovation, either by overlapping creativity with the implementation of ideas or by placing innovation as part of the generation process; when the differentiation between the constructs was mentioned, one framework stood out above all. Drawing knowledge from Amabile's componential model of creativity and innovation in an organization, academic research has distinguished between creativity and innovation with creativity corresponding to generating new and useful ideas and innovation implementing them. Amabile's framework advances the notion that creativity is placed before ~~the~~ innovation and that the result of creativity (the generated creative idea) is the needed outcome for the innovation process to begin with. Neuroscientific research looking into the process of creativity has agreed with the way Amabile's componential model proposes the stages of the process of creativity.

According to the combination of organizational and managerial literature creativity ends in ~~which ends in~~ a generated idea and innovation in implementing the idea that already exists. This review, therefore, finds this differentiation between creativity and innovation to be acceptable (Beaty et al. 2016; van Knippenberg 2017).

The second purpose of the systematic literature review was to shed light on the important factors influencing creativity and innovation, specifically within the context of organizations. For a full future conceptual model outlining the creative-innovative process, the variables affecting it will play a role in measuring creativity and innovation processes as well as being useful directly within organizations.

The literature review specifically focused on cognitive and psychological factors affecting the creative-innovative process (Fig. 1). Despite years of studying the constructs, the knowledge from psychology and cognitive neuroscience hasn't been translated properly towards management and organizational research and they are crucial to understanding creativity and innovation to its fullest (van Knippenberg 2017; Perry-Smith and Mannucci 2017). In fact, Amabile's componential model mentions the importance of 'creativity-relevant processes', for the process of creativity within the organizational context, however, organizational research has not explored the antecedents of creativity-relevant process from the fields of neurobiology and psychology and it would benefit immensely from it, especially in the further empirical exploration of the creative-innovation process.

Fields of neurobiology and psychology, as well as cognition, are very prominent for research into creativity – and, specifically, generation and evaluation of generated ideas because it is usually considered a mental process, however, doesn't mean that it is innate. Organizational literature can benefit from it as neurobiological literature provides clear evidence of

psychometric constructs that are already used for recruiting and management purposes (van Knippenberg 2017; Perry-Smith and Mannucci 2017). The availability of ~~ready~~ psychometric tests for these creativity-relevant processes will be essential in measuring creativity and innovation specifically within the context of organizational research (Amabile and Pratt 2016). The ease of measurement via the use of neuroimaging and psychometric tests would help create strategies to foster and promote creativity within organizations, as well as in learning techniques that can promote creative and innovative outcomes. Since creativity is not only an innate ability; but, the environmental and social contexts that influence it, shown by various literature and is prominent within Amabile's organizational framework, it is possible to learn and train strategies to enhance creativity and innovation (Amabile and Pratt 2016; Tang 2019).

From neuroscientific literature, research points out the importance of two stages within the initial stages of creativity. Functional connectivity is present between two important network hubs – DMN and ECN, as well as the prominence of the salience network (Beaty et al. 2016; Boot et al. 2017; Khalil et al. 2019; Lucchiari et al. 2018). This is crucial for further building a conceptual map of the creative-innovative process as it corresponds to the stages of the creative process that are outlined in Amabile's theoretical framework (Amabile and Pratt 2016). The two-stage process identifies various concepts relevant to the processes and this review looked at two main streams of literature coming from neuroscience and cognitive psychology findings and management findings. The goal was to identify ~~Identification of~~ the concepts and constructs that can be applied within the organizational context with the further goal of measuring them to facilitate strategies that promote creativity and innovation within organizations.

The tie of certain cognitive concepts (e.g. cognitive flexibility and persistence) is relevant because their involvement in the creative-innovative process has been proven with

neuroscientific research and the activation of the DMN and the ECN networks. Brain activity is easily measured and deriving cognitive concepts that can influence creativity and innovation within organizations and proving their involvement within the process via neuroimaging methods or psychometric scales allows organizations to use the knowledge of these concepts for their benefit in creating strategies that facilitate creativity and innovation. For example, this could provide some interesting potential for further research, as well as application to practice with the use of the neurofeedback technique where participants are shown their brain and neuronal activity online, in an attempt to see whether they could consciously change this activity. This could be an interesting avenue for promoting creativity, such as tDCS neuromodulation (Stevens and Zabelina 2019).

Apart from organizations just gaining knowledge about the relevance of these concepts and the two-stage process influenced by various cognitive variables, it is beneficial to study them because organizations can create training and development programs to facilitate creative thought processes and innovative workshops. Organizations can also have a better idea of team members for task assignments; as well as recruitment for innovation goals within the company.

Contribution

This research contributes to the academic body of knowledge on creativity and innovation by providing a systematic literature review that combines theories and research from a multidisciplinary points of view, from those disciplines that often do not converge together in one academic paper. By presenting neuropsychology and managerial literature together, this review showcases the potential for identifying relationship patterns among different components relevant for the processes of creativity and innovation. In fact, authors of the disciplines have been asking for a complete model of creativity and innovation (Amabile, 1988b)(Amabile,

1988b). This literature review can help guide the building of a future conceptual framework of creativity and innovation and following the pre-requisites established by prominent authors within the discipline (Amabile, 1988b)(Amabile, 1988b). According to Amabile, a complete future model would promote further research within the topic of creativity and innovation; would guide research in the right direction to where the biggest gaps in knowledge pertain; as well as would integrate previous knowledge and prompt empirical examination of the model (Amabile, 1988b)(Amabile, 1988b). This systematic literature review can serve as a baseline for future research that plans to investigate creativity and innovation from a theoretical, as well as empirical points of view as the understanding of the differentiation between creativity and innovation is improved with the paper.

CONCLUSION

Creativity and innovation differentiation is an important distinction within the academic world because it allows for further exploration of the concepts separately and seeing the relationship between the two more clearly. A clear understanding of the conceptualization of the two concepts is essential for further research into the empirical evidence in the creative-innovative process, which is something that has been lacking up to this point (Amabile and Pratt 2016). In fact, many authors specify the lack of empirical examination of the creative-innovative process and, therefore, having a conceptual model stemming from the clear conceptual distinction between creativity and innovation is essential for that to be able to apply the model to organizational contexts.

This review looks at the concepts of creativity and innovation from disciplines that are sometimes disregarded by one another, at least in the academic world; such as neurobiology and management; however, might provide fruitful insights and even strategies for further work and

application to the industry. This review, therefore, looked at articles within neurobiological and managerial fields – attempting to determine important factors for creativity and innovation to create a certain consensus between the results found.

This review certainly had limitations. It looked at the individual level of the process of creativity and innovation because it is a natural first step before moving into other levels, however, future research should explore looking at the group and organizational levels and constructs that will affect creativity and innovation in those levels.

This systematic literature review provides up-to-date literature on creativity and innovation research progress over the past few years and opens up an avenue for further creation of conceptual models, as well as an empirical examination of creativity and innovation within the organizational context. It is important to create a method to measure creativity and innovation correctly because to date, scales, tests and self-measuring measures of the creative-innovative process are inconsistent (Amabile and Pratt 2016). Apart from that, the precise mechanism and relationships of all the variables and mediators that have been identified throughout the systematic review have not been identified yet. It would be interesting to see which variables and factors affect one another and to check the level and the exact way the factors work to affect creativity and innovation and the positive and negative associations the concepts have with the processes of creativity and innovation, which provide a context for further research.

The systematic search only included reviews in its search and, perhaps, could have also benefitted from searching for empirical articles over the past five years. A specific systematic literature review with similar inclusion and exclusion criteria review and keywords searching only for empirical articles over the past five years could be a very fruitful addition to this work to

provide a fuller framework of the factors influencing both creativity and innovation on an individual level.

CHAPTER 3

OPENING DOORS TO NEUROPSYCHOLOGY: INTEGRATING THE DPMC MODEL INTO THE COMPONENTIAL MODEL TO ENRICH CONCEPTUALIZATION OF INDIVIDUAL CREATIVITY WITHIN ORGANIZATIONS

Abstract

We integrate neuropsychology theory into the organizational theory to conceptualize individuals' creativity within organizations. Creativity in organizations has been conceptualized by research from various social disciplines. However, results have shown inconsistency partially because organizational research explores creativity from the creative outcome point of view and its determinants, overlooking the internal biological process of creativity taking place in individuals' brains. This has led to difficulties in operationalizing creativity within the organizational innovation process. Our research proposes to integrate the main contributions of the neuropsychological Dual Pathway Model of Creativity (DPMC) into the organizational componential model of individual creativity. It does so through a narrative literature review. We found that the two DPMC cognitive pathways – cognitive flexibility and persistence – are influenced by each of the individuals' components affecting the stages of the creative process proposed by the componential model of creativity: motivation, skills in the task domain, and creativity-relevant processes. We also found that both pathways intervene in all stages of the organizational creative process, from task presentation to outcome assessment. Results configure an enriched vision of the componential model in which new relationship patterns among the

individual components of creativity and the stages of the creative process emerge. This contribution leads to higher operationalization for managers to foster individual creativity in organizations because the enriched version allows measuring creativity in its generation process, avoiding the sole reliance on creative outcomes.

Keywords: creativity; cognitive flexibility; persistence; organizations; Dual Pathway Model; componential model

Introduction

Recently, attention has been placed on creativity as a drive for progress in organizations, leading to achievement and competitive advantage (Bisbe & Malaguenõ, 2015; Hughes et al., 2018; Madrid et al., 2019). Despite undeniable advances in creativity conceptualization, this has resulted in a lack of clarity, consensus, and operationalization of the concept within the particular organizational setting (Acar et al., 2019; van Knippenberg, 2017). To address this gap, Amabile and Pratt (2016) have insisted on the need to adopt a dynamic perspective in the understanding of the creative process, particularly by "focusing (…) on the individual-level psychological processes implicated in creativity" (Amabile & Pratt, 2016b, p. 1). Moreover, extant research on individuals' psychological factors responsible for provoking creative behaviors within organizations looks at the end-product of creativity or specific stages of the general creativity process. In doing so, it fails to unveil how individuals internally produce creative behavior, missing a structured understanding of the individual components' role and interrelation. This derives from operationality problems (Acar et al., 2019; Amabile, 2017; Hughes et al., 2018;

Said-Metwaly & Kyndt, 2017; van Knippenberg, 2017; Walia, 2019, p. 1) and hinders creativity promotion in organizations (Perry-Smith & Mannucci, 2017; van Knippenberg, 2017).

The componential theory of creativity and the componential model of creativity provide one of the most comprehensive ways of understanding the dynamic properties of creativity within organizations. The theory and the model focus on different individual factors – components – that affect individual or small-group creativity through different stages to reach organizational innovation outcomes (Amabile, 1988b; Amabile & Pillemer, 2012; Amabile & Pratt, 2016b). Dynamism is granted by a conceptualization of creativity based on the connections and interactions between individuals' components and the different stages of the creative processes; components would act as "expanded motivational drivers [that] could motivate multiple "loops" or iterations through the stages" (Amabile & Pratt, 2016b, p. 177).

Despite the relevance of the componential view of creativity within organizations, its authors recognise some lack of progress in its "empirical examination ." Notably, they call for further examination of the relationship patterns among the individual components of creativity (Amabile & Pratt, 2016b, p. 179), which requires more work to examine individuals' psychological processes present during the creative process.

Neuroscience can bring light to the issue. The DPMC is a neuropsychological model of creativity indicating that various situational variables and cognitive components may lead to creativity via their effect on two pathways in brain activity – cognitive flexibility and persistence (Nijstad et al., 2010b). Through a narrative literature review, our research proposes to integrate the main features of the DPMC – as an explanation of the internal neuropsychological processes of creativity – into the componential model – as an explanation of the creativity process within organizations. We introduce into the organizational process the two cognitive pathways of brain

activity that the DPMC recognises as responsible for creative work in individuals – i.e., cognitive flexibility and persistence. In doing so, we utilize brain activity as a mediator in the components-outcomes relationship of the creative process. This enriches the understanding of the interrelation pattern among individual components present in the componential model; it thus enriches the conceptualization of organizational creativity and its operationalisation as it shows a new perspective for managing and measuring the impact of components over creative outputs.

Methods

Considering the purpose and nature of the paper, the research goal was addressed through a narrative literature review. We undertook a comprehensive synthesis of extant works, presenting their results in a summarized form and aiming to provoke further discussion, effective for topics studied across multidisciplinary research, and expected to bring light to complex topics (B. N. Green et al., 2006; Snyder, 2019).

The paper selection and analysis were organized in 3 stages. Selected papers were found in literature from the "traditional" disciplines feeding organizational management – i.e., organization, business, sociology, psychology, and work and organizational psychology –and disciplines related to neuroscience – i.e., cognitive sciences and neuropsychology. In all stages, we searched identified search terms in abstracts, titles, and keywords of papers. In all stages, we filtered papers based on the common inclusion-exclusion criterion that selected papers had to be relevant for the purpose of this research.

First stage: key search terms identification and initial works selection.

This first stage consisted of five consecutive searches of literature reviews published in English and journals indexed by JCR and SJR.

In the first search, we focused on literature reviews. We utilized the two search terms with the broadest scope: “creativity” and “innovation,” to identify further topics and themes to explore regarding our objectives. The identification of other search terms heavily depended on the literature found in the first search and on insights from the componential model of creativity (Amabile, 1988b; Amabile & Pratt, 2016b) as found to be the most cited framework for creativity and innovation in organizations. According to previous literature, this type of search method is consistent with correctly recognizing search terms (Hernández-Torrano & Ho, 2021).

This first search helped identify the rest of the key search terms. We found that organizational management literature emphasizes ‘performance’ when mentioning either creativity or innovation, pointing to how the performance is affected by the constructs. ‘Cognition’ was another important word since it plays an overarching role over many other concepts discussed concerning creativity and innovation, especially within the neurobiological literature. Similarly, ‘personality’ or its components, such as the ‘big 5,’ appeared in most literature. ‘Motivation,’ one of the major components identified in the componential model of creativity, was supported by a myriad of management and neurobiological literature and, therefore, was also chosen as one of the key search terms for this paper.

Being reviews of literature, works identified in the first stage included the knowledge gathered from previous literature, and a five-year cut-off was chosen to reach the literature that provided the most updated knowledge (Acar et al., 2019; Xiao & Watson, 2019).

Consecutive stages did not put a limit on years and included empirical papers, as well as literature reviews.

The first stage resulted in 54 papers found as follows:

- **1st search:** “creativity” and “innovation” search terms; 8 reviews found;
- **2nd search:** “creativity” and “performance” search terms; 31 papers found;
- **3rd search:** “creativity” and “cognition” search terms; 11 papers found;
- **4th search:** “creativity” and “personality” search terms; 4 reviews found;
- **5th search:** “creativity” and “motivation”; did not include any reviews due to repeated papers.

Second stage: expanding the scope for paper selection.

The second stage allowed for a broader search scope regarding publication year, the paper's nature, and the publication type. It involved deeply examining the 54 selected reviews, particularly their references. This resulted in 12 reviews being discarded and 15 new articles included, in total, 57 selected papers.

Then a new separate search was undertaken in each key discipline: “Behavioral sciences,” “Management” “Social Psychology,” “Psychology,” “Neuroscience,” and “Neurobiology”; top ten journals of each discipline were searched utilizing two main search terms ‘innovation’ and ‘creativity’ in two searches. The time and nature scopes were widened; 14 other papers were included, leading to a final and total refined selection of 71 papers.

2.4 Third stage: works content analysis.

Content analysis was carried out on the 71 papers following the narrative method. We synthesized each paper, identifying the main concepts and arguments for the research purpose. The content analysis of the literature underwent three substages, consistent with how narrative

literature reviews work (B. N. Green et al., 2006). First, we looked at how each of the papers treated the search terms identified in the previous stages of the literature review. We looked at the top results and contributions of each identified paper. As a result, we identified key individual neuropsychological constructs affecting creativity, and already present within the componential model that identifies them as individual components. Second, we extracted the relationships between these individual neuropsychological constructs and the search terms identified in previous stages of the literature review and between the constructs themselves. Within these relationships, we frequently found two neuropsychological constructs absent from the componential model of creativity coming – cognitive flexibility and persistence pathways. We found that these pathways affect creativity through the individual neuropsychological constructs and that both are presented in a neuropsychological model – DPMC.

Neuropsychological literature allowed looking at cognitive flexibility and persistence, not just from a psychological point of view but also from a neuroscientific point of view. It provided information on the brain networks present within the process of creativity and reaffirmed the involvement of the individual components present within the componential model of creativity. Once identified in the componential model, those individual components were further researched within neuropsychological literature to get a more holistic view of them from both neuropsychological and organizational literature and see their effect on cognitive flexibility and persistence.

Conceptualizing creativity

According to the componential model of creativity, the goal of creativity is "the production of novel and useful ideas by an individual or small group of individuals working

together." (Amabile, 1988b, p. 126). This differentiates it from innovation, which requires creativity to exist. Amabile points out that without creativity, innovation would not exist. Innovation would then be "the successful implementation of creative ideas within an organization" (Amabile, 1988, p. 126). The DPMC model aligns with the componential model by seeing the goal of creativity as "the production of ideas, problem solutions, and products that are both novel (original) and appropriate (feasible, potentially useful) (Nijstad et al., 2010b, p. 35).

However, some studies define creativity by connecting it with innovation in a distinct way from Amabile's model. Some view creativity as a part of an innate ability that people might have (e.g., equating it to motivation); or as divergent thinking, a different type of thinking that can produce original ideas in comparison to ordinary or convergent thinking; others define it as an "identification of an unsolved problem" which does not take into account the process of producing an idea (Jia et al., 2019; Walia, 2019, p. 1). Other researchers disagree with Amabile's view of creativity by saying that limiting the definition of creativity to only generating novel and useful ideas disregards all of the literature that expands the concept into the implementation processes (van Knippenberg, 2017; Walia, 2019). This sets research apart from Amabile's path since it proposes disregarding a lack of a clear definition of creativity and innovation to permit a broader literature review scope. Creativity literature that includes implementation processes would be done differently if the lack of consensus between definitions did not exist. While overlooking literature could be limiting, it should not stop research from moving forward and establishing clear, accepted definitions for creativity and innovation.

From a neuropsychological point of view, the internal process of creativity, some literature presents creativity as "a process of random (or blind) variation and selective retention"

(Nijstad et al., 2010b, p. 36). This literature argues that creativity results from brain activity creating different scenarios to the previously existing ideas by chance, like other biological processes that create new connections and pathways within the brain (Nijstad et al., 2010). Creativity is then seen as ideas that are selected based on their possibility of being useful, involving an environmental and outside opinion on the idea's usefulness (Nijstad et al., 2010). This line of research operates on a similar definition as the one proposed in the componential model of creativity – generating ideas that are novel and useful since those ideas considered useless by the creator or the society are disregarded.

Other researchers suppose that creativity is an innate cognitive capability humans possess and develops as problem-solving in the real world. Authors supporting this theory argue that environmental factors have a significant influence on the cognitive functioning of human beings and, therefore, on creativity. The random selection of ideas presented in the previous line of thought is also present here, with creativity being regarded as novel ideas generated and retrieved from previously existing associations within memory that then evolve into a creative idea.

Some literature refutes the theories that claim creativity is related to problem-solving since "problem-solving requires focused attention, effort, and systematic, analytical processing, creativity benefits from defocused attention and unsystematic (random) processes (e.g., spreading of activation) (Nijstad et al., 2010, p. 40). These researchers base their theory on latent inhibition, an adaptive ability of the human brain that allows the brain to turn away distracting stimuli already introduced beforehand (Nijstad et al., 2010, p. 40). Those more creative individuals seem to have a reduced ability for latent inhibition and, therefore, entertain random stimuli to enter their brains and become cognitively processed, potentially leading to more novel and useful ideas (Nijstad et al., 2010, p. 40). This paper embraced the definition of creativity

proposed by the componential model of creativity supported by up-to-date research from neuroscience, including the DPMC model.

3.2 Componential model of creativity

The componential model explains "individual creativity and process of organizational innovation, as well as ways in which the two are linked through mutual influence" and places creativity as key for organizational innovation (Amabile & Pratt, 2016, p. 158). The basis for the original version of the model encompasses findings on creativity regarding "the importance of talents, education, cognitive skills, interest patterns, and personality dispositions, all functioning interactively to influence creative behavior, as well as a motivational state marked by both deep involvement and intellectual playfulness" (Amabile, 1988, p. 130). From combining the knowledge from these modalities applied to organizational science, Amabile made the model and created the three major groups of components that contain individual influences on creativity: domain-relevant skills – acquired technical skills and knowledge and innate ability or talent that the person possesses for the specific task or domain –, creativity-relevant skills – cognitive abilities and personality traits providing an extra push and potentially going from adequate performance to exceptional performance –, and intrinsic task motivation – the driver determining what an individual *can* do and what one *will* do (Amabile & Pratt, 2016, p. 133).

According to Amabile's model, the higher the level of each of the major umbrella components, the higher the creative output will be; however, it specifies that different components have a different effect on each stage of the creativity process (presentation of the task; preparation stage, idea generation stage, idea validation stage, and outcome assessment stage). Understanding the interrelationship among components and stages of the creative process

becomes all the more crucial. Amabile views the individual components as "the building blocks" of the process of creativity and says that each component is an essential part of the process, and the components alone are not enough to successfully achieve creative idea generation (Amabile, 1988, p. 137). According to the model, the components need to interact with one another, and if one of the components is not present, the appropriate level for a creative idea to be generated will not be achieved (Amabile, 1988). Indeed, the sum of the individual levels of each component and their interrelation with one another determine "the final level of creativity achieved" (Amabile, 1988, p. 139). Understanding the specifics of this interrelation pattern is essential for understanding and applying the model (Amabile, 1988; Amabile & Pratt, 2016).

3.3 Dual Pathway Model of Creativity

While DPMC supports Amabile's definition of creativity, it looks at the process from a neuropsychological and cognitive point of view. DPMC lies in neuropsychological research showing brain area activation when individuals generate novel and useful ideas (Nijstad et al., 2010). Neuroimaging studies show that people acknowledged for creative skills can switch back and forth between two patterns of brain connectivity when engaged in creative activities (Beaty et al., 2016b, 2019; Chrysikou, 2019; Dietrich, 2019; R. E. Jung & Chohan, 2019). DPMC indicates that two additional distinct processes occur in our brain that can lead to a creative idea. Those two processes are cognitive flexibility or persistence pathways. Cognitive flexibility refers to mind-wandering that brings flexibility into thought pattern processes by allowing one to switch easily between different ideas and categories (Boot et al., 2017; Chrysikou, 2019; Khalil et al., 2019; Nijstad et al., 2010b; Zabelina & Andrews-Hanna, 2016). Persistence refers to the capacity to focus on pertinent information and ignore distracting information to focus attention

on the task (Nijstad et al., 2010). It increases performance in tasks requiring selective attention and purposeful investigation of creative prospects (Amer et al., 2016). Accordingly, creativity works from spontaneity and imagination and a controlled and purpose-driven search of existing reality.

The presence of two distinct brain activations has led neuropsychologists to believe that there are two steps in the creative cognition process: idea generation and self-evaluation (Beaty et al., 2016b; K. C. Fox & Beaty, 2019; Kleinmintz et al., 2019). The idea generation process is the first step of creative cognition and utilizes bottom-up processing, mind wandering, and "internally-focused attention" (Beaty et al., 2019, p. 24). Both cognitive flexibility and persistence activation are responsible for the second step, idea evaluation – revising the quality of generated ideas (Beaty et al., 2016b; Kleinmintz et al., 2019).

The two DPMC pathways allow for a deeper understanding of the role played by individuals' traits in their creative process. Neuroimaging and experimentation on transcranial direct stimulation have shown specific brain activation when mind-wandering is engaged (Lucchiari et al., 2018). They have also demonstrated a different brain activation when cognitive processes requiring focused control and attention are engaged, such as keeping goals in mind, working memory processes, or task switching (Beaty et al., 2016b; R. E. Jung & Chohan, 2019).

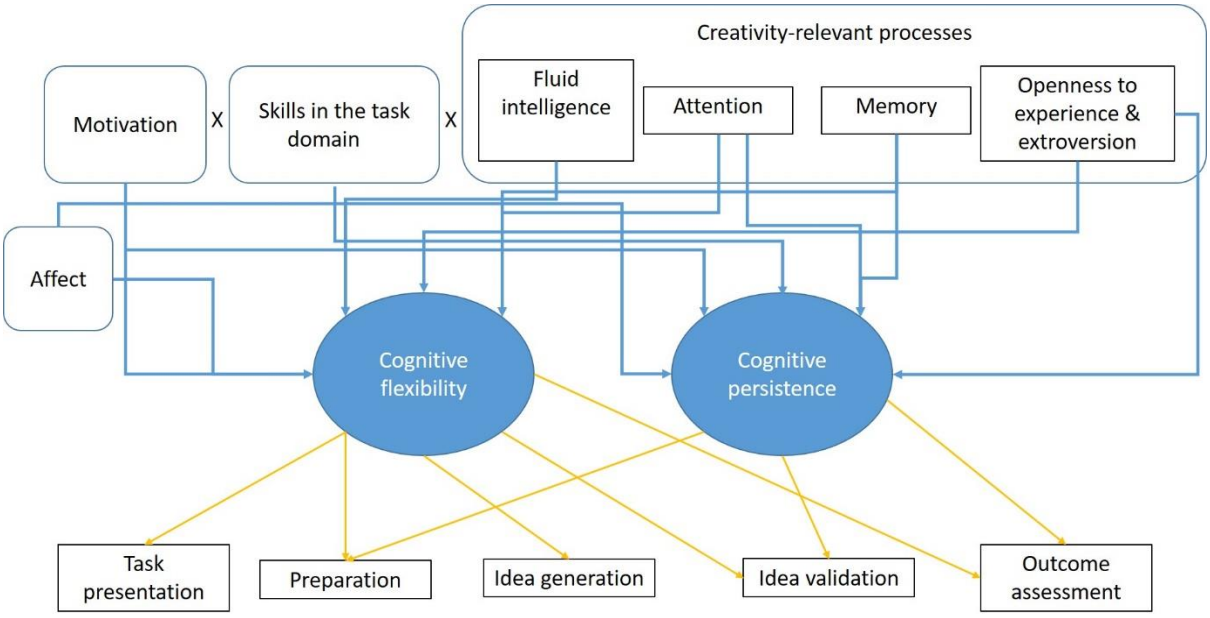
The two brain activities are stimulated by different characteristics and in different contexts. DPMC is a neuropsychological model that presupposes how different dispositional or situational variables connect to creativity "because they influence cognitive flexibility, or because they influence cognitive persistence, or both" (Nijstad et al., 2010). It can help understand how and why individual components provoke outcomes in each stage of an organization's creativity process.

It is possible to apply neuroimaging techniques to measure cognitive flexibility and persistence(Chrysikou, 2019; Di Domenico & Ryan, 2017; Jia et al., 2019; Lucchiari et al., 2018; Perry-Smith & Mannucci, 2017; Rubenstein et al., 2018; Zabelina & Andrews-Hanna, 2016). This would force organizations to use resources-consuming neuroimaging techniques typically used in neuroscientific research contexts. (Nijstad et al., 2010b; Wu & Koutstaal, 2020b). However, different psychometric tests and techniques exist to capture brain activation in both pathways. Some examples are the Alternative Uses Task (AUT) (Vartanian et al., 2020; Yu-chu Yeh et al., 2019), the Trail Making Test B (TMT-B) (Hou et al., 2016; Lin et al., 2021), and the Self-Guided Transition (SGT) technique.

Integrating DPMC into the componential model

Calling on the findings of our narrative literature review, we propose introducing the DPMC cognitive pathways as mediators of creativity influenced by individual components such as skills in the task domain, creativity-relevant skills, and task motivation. This leads us to an enriched version of Amabile and Pratt's componential model of creativity in organizations, as shown in Figure 1.

Figure 1. An enriched version of Amabile and Pratt's componential model of creativity in organizations



One first result of the review has been identifying the DPMC pathways' involvement in each creativity process stage of the componential model. It sheds light on the lower half of Figure 1. We have been able to do so by conceptually aligning each stage definition regarding tasks in each stage with cognitive pathways, as claimed by neuropsychology. In doing so, we find that the task presentation stage is associated with cognitive flexibility as it involves the identification of goals and planning and involves an influence of intrinsic motivation since people have to be open and flexible about looking at different approaches when presented with a creative activity before looking at it more systematically in the next stage (Nijstad et al., 2010). The preparation stage involves learning about tasks and gathering necessary information; therefore, it seems close to working memory processes and thus associated with persistence. The idea generation and idea validation stages of Amabile's model correspond to the idea generation and self-evaluation stages recognised by DPMC, with the first being affected by cognitive flexibility and the second by cognitive flexibility and persistence. The outcome assessment stage

is like the DPMC self-evaluation stage – evaluation of generated ideas and decision-making regarding further steps for created ideas; it is associated with flexibility and persistence.

The second result of our review gathers the identification of the roles played by specific individual components in activating persistence and/or flexibility, allowing us to learn about the intricate dynamics of achieving creativity.

Literature shows that intrinsic motivation pushes individuals to search for originality and to increase their competency in any activity, to inspect novel things, to acquire new information, and to find tasks thought-provoking and absorbing, as well as to feel a sense of enjoyment and fulfillment from engagement (Di Domenico & Ryan, 2017; Khalil et al., 2019). It is considered a pre-requisite for the generation of creative ideas and thus an essential element of the creative process (Amabile, 1988b; Di Domenico & Ryan, 2017; Gerhart & Fang, 2015; Khalil et al., 2019; Rubenstein et al., 2018; Shalley et al., 2004b; Shalley & Koseoglu, 2016). Many neuroscientific studies support the association of cognitive flexibility with intrinsic motivation, also showing a relationship with persistence (Di Domenico & Ryan, 2017). Research also shows that extrinsic motivation can positively correlate with persistence under certain conditions and increase creativity (Baas et al., 2013; Miller & Hom, 1990; Nijstad et al., 2010b).

Domain expertise is relevant for organizations to succeed in a role, maximizing individual performance and continuously expanding to keep up with ever-changing competitive markets (Yayavaram et al., 2018). Research shows that skills in the task domain are essential for people to engage in creativity, primarily because the idea's utility must be judged by the field in which ideas are generated (Amabile & Pratt, 2016; Nijstad et al., 2010). More original ideas are generated when people have previous knowledge and an in-depth study of a topic, activating persistence and compensating for the lack of cognitive flexibility by focused attention (Nijstad et

al., 2010). This corresponds to the idea preparation and idea validation stages of the componential model, requiring persistence for successful completion (Amabile & Pratt, 2016; Nijstad et al., 2010).

The *attention* component has gained much interest in organizational literature due to recent evidence that mindfulness practices help focus, behave with awareness, and improve individual-level creativity as a result (Baas et al., 2020). This associates attention with cognitive flexibility. At the same time, mind wandering shows that engaging in high cognitive capacity-demanding work engages participants in daydreams related to problems and positively affects creativity (M. Baer et al., 2020), linking attention with flexibility. The componential model mentions the influence of positive and negative mood on attention – with positive affect widening attentional focus – persistence –and negative mood reducing attentional focus to become more detail-oriented – flexibility (Amabile & Pratt, 2016).

Therefore, neuroscientific findings provide evidence that attention is essential for cognitive flexibility and persistence. Inward-directed attention and broader attentional focus allow thoughts requiring more information and flexibility, and external attention, where more detailed attention is applied with purpose, calls for persistence (Amer et al., 2016; Beaty et al., 2016b, 2019; Benedek & Fink, 2019; Boot et al., 2017; Chrysikou, 2019; Di Domenico & Ryan, 2017; Gu et al., 2018; Heilman, 2016; Jia et al., 2019; R. E. Jung & Chohan, 2019; Khalil et al., 2019; Lucchiari et al., 2018; Marron & Faust, 2019; Nijstad et al., 2010b; Rubenstein et al., 2018; Stevens & Zabelina, 2019; Zabelina & Andrews-Hanna, 2016).

Attention is essential in the self-evaluating stage, with individuals filtering out all that is unnecessary to the task (Amer et al., 2016; Beaty et al., 2019; Chrysikou, 2019; Di Domenico & Ryan, 2017; Gu et al., 2018; Rubenstein et al., 2018). There is a trade-off between flexibility and

persistence, where a more narrow attentional focus might harm flexibility. However, a broader attentional focus only lets one focus more precisely on the task. This corresponds to the knowledge from the componential model, with different stages of the creative process requiring a more flexible or more persistent approach (Amabile & Pratt, 2016; Nijstad et al., 2010). Positive mood, broader attentional focus, and cognitive flexibility activation are related to the first and the third stages of the componential model, and negative mood, narrow attentional focus, and persistence activation to the second and the fourth stages of the creative process, which is consistent with DPMC findings (Amabile & Pratt, 2016; Nijstad et al., 2010).

Studies have shown that during creative task engagements, *working memory capacity* is related to persistence, but a high level of working memory capacity also increases cognitive flexibility and allows for more creative problem-solving – showing that trade-off between the two pathways. A trade-off between cognitive flexibility and persistence is relevant for the stage separation of the creative process from the componential model. It highlights the delineation of activation of one or the other pathway depending on the influence of working memory.

Those who have a higher working memory capacity (quantity of information kept within working memory at any given time) show to have the ability to hold onto relevant decision-making information for longer, maintaining it within their attentional focus, as well as improve performance within organizations (Laureiro-Martinez et al., 2019). According to DPMC, there is a play-off between flexibility and persistence when it comes to working memory, so cognitive flexibility and persistence play a role in memory processes (Nijstad et al., 2010). Cognitive flexibility decreases cognitive control and allows for more remote associations, however allowing for more distractions and less focus on the task, while persistence engages more

cognitive control to only focus on relevant thoughts that come into working memory; however, compromising more flexible and original ideas (Nijstad et al., 2010).

The componential model positions memory as essential for gaining expertise for the task; it is highly associated with cognitive functions and differences with cognitive control, signifying a relationship with persistence (Amabile, 1988b; Amer et al., 2016). Neuroscientific research shows that memory is vital for idea generation, where associations happen spontaneously, and idea self-evaluation, where the search for further extraction of task-required information occurs (Kenett & Faust, 2019; Silvia, 2015). Novel and useful ideas do not come out of thin air but are outcomes of already present information modifications, specifically of less associated with one another items (Benedek & Fink, 2019; Kenett & Faust, 2019).

Researchers debate the existence and the intricacies of the relationship between *intelligence* and creativity (Amer et al., 2016; Benedek & Fink, 2019; Boot et al., 2017; Gu et al., 2018; Heilman, 2016; Jia et al., 2019; R. E. Jung & Chohan, 2019; Khalil et al., 2019; Rubenstein et al., 2018; Silvia, 2015). Do people need to have a certain level of intelligence to be creative, and does the level of intelligence that individuals possess need to be specific to the presented activity? Organizational researchers questioned the traditional view of intelligence because IQ measurements are insufficient for higher job success (Sternberg, 1997). Management literature points out the benefits of having a different kind of intelligence, allowing employers to look at all issues in a new light and promoting workplace creativity (Sternberg, 1997). Along with this view, the componential model presupposes intelligence as a component of the creative process and says that traditional views of intelligence are not enough for engaging in the creative process (Amabile, 1983b, 1988b).

Fluid intelligence is the subtract of general intelligence associated with an individual's ability to create solutions to problems and think logically regardless of previous knowledge level(Khalil et al., 2019; Silvia, 2015). It is related to rational thinking and executive control. It associates with creativity and positively correlates with creative outcomes. The ability to switch between ideas predicted such an effect on creativity, thus correlating with cognitive flexibility (Colzato et al., 2006; Khalil et al., 2019; Silvia, 2015).

Researchers also emphasize *personality* differences, work performance, employee engagement & job satisfaction (Neal et al., 2012; Smallfield & Kluemper, 2021; Young et al., 2018). Openness to experience is positively related to individual work proactivity and adaptability to different working contexts but negatively to organizational proficiency (Neal et al., 2012). The componential model mentions the importance of personality characteristics for creativity, with individual differences having a predictive functioning for the success of creative ideas (Amabile & Pillemer, 2012).

Neuropsychological research showed that certain personality traits are related to creative potential and predispose engagement in tasks requiring creativity (Feist, 2019; Jauk et al., 2014; Puryear et al., 2017). Studies report the presence of openness to experience as a pre-requisite for engaging in creative tasks (Beaty et al., 2019; Feist, 1998b, 2019; Gocłowska et al., 2019; Jauk, 2019; R. E. Jung & Chohan, 2019; Kandler et al., 2016; S. B. Kaufman et al., 2016; Lucchiari et al., 2018; Puryear et al., 2017; Ren et al., 2019; Shalley et al., 2004b). Traits such as agreeableness, conscientiousness, and neuroticism seem to hinder creativity; however, results appear inconclusive (Feist, 2019; Gocłowska et al., 2019; Perkins et al., 2015; Puryear et al., 2017). Low scores in agreeableness promote creative thought processes when the environment is against novelty, while other studies find a low association with agreeableness overall,

conscientiousness, and neuroticism (Feist, 2019). According to neuroscientific research and DPMC, openness to experience is related to thoughts processes that explore many ideas at once (Mussel et al., 2015), showing a positive association with cognitive flexibility (Baas Matthijs et al., 2011; Feist, 2019; Nijstad et al., 2010b).

Affect plays a significant role in the organizational context as an essential element for "positive job-related outcomes" (Madrid et al., 2014, p. 248). Both componential and neuropsychological DPMC models have not overlooked the construct. The dynamic componential model specifies that creativity strongly relates to affect; and engaging in purposeful work, regarding it as a significant influence on intrinsic motivation and creativity-relevant skills (Amabile & Pratt, 2016). According to the componential model, positive affect has been positively associated with creativity in several studies, with negative and ambivalent affect potentially having an indirect positive effect on creativity (Amabile & Pratt, 2016). Similarly, DPMC and other neuroscientific findings discuss the importance of affect and mood states on creativity – with positive mood increasing cognitive flexibility and negative mood increasing persistence (Khalil et al., 2019; Nijstad et al., 2010). DPMC findings correspond to the affect's influence on stage separation on the creativity process proposed in the componential model (Amabile & Pratt, 2016; Nijstad et al., 2010). Positive affect can influence intrinsic motivation due to its motivational nature and is vital during stages 1 and 3 of the creative process. In contrast, negative and ambivalent affect is significant for stages 2 and 4 due to focused attention (Amabile & Pratt, 2016). It shows how they relate to cognitive flexibility and persistence – stages 1 and 3 are more associated with cognitive flexibility, and stages 2 and 4 with persistence (Amabile & Pratt, 2016; Nijstad et al., 2010).

Discussion

Establishing clear relationships between the componential and the DPMC models provides a new, enriched vision of the creative process in organizations. Many scholars have discussed how creativity originates, and this paper, to the best of our knowledge, is the first to shed some new light by combining frequently divergent disciplines. By integrating neuropsychology into organizational management, our framework is the first that lays the setting for identifying the relationship patterns among different components that dynamically affect the process of creativity through different stages.

Utilizing DPMC's cognitive flexibility and persistence and taking advantage of its social-psychological nature proves useful for organizations. Applying the organizational context as a DPMC situational variable and the componential model components as DPMC's dispositional variables helps delineate stages proposed in the componential model and the effect of the two cognitive pathways on the process overall.

Our enriched version of the componential model provides a baseline for future studies that can explore individual components in depth by seeing their relationship with creativity via their influence on cognitive flexibility, cognitive persistence, or both. It can also be applied to various situational contexts, specifically organizational and managerial settings, and testing the individual components such as personality traits or attentional focus and working memory capacity during a specific work task. Testing these individual components' relationships with creativity via cognitive flexibility and persistence helps individuals and organizations create strategies that can help foster the creativity process stage by stage by paying attention to the critical elements and components that have an effect at those time points of the creativity process. Organizations could increase the quality of creative ideas generated by presenting

problems that go together with individual pre-dispositional characteristics. Managers and those with decision-making responsibilities will have an easier time distributing creative tasks based on individual differences.

This allows for strategies adaptable to the dynamic nature of the creativity process. The dynamism of the enriched model building on the dynamism of the componential model of creativity allows looking at the whole process of creativity *versus* just the creativity outputs, which is something that much literature has focused on beforehand (Acar et al., 2019; Hughes et al., 2018; Said-Metwaly & Kyndt, 2017; van Knippenberg, 2017). By highlighting creativity-relevant skills, the model opens a gate to operationalizing their effect on creativity via cognitive flexibility and persistence pathways.

Deviating focus from creativity outputs to a dissected creativity process built upon two measurable cognitive pathways provides approaches for assessment and management operationalization. Components can be experimented with separately or in combination to look for their synergistic effect on creativity. For organizations looking for creative output, this enriched view will be of immense help offering a way to maximize someone's individual characteristics for organizational benefits and boost creative performance, as well as an increase in novelty and usefulness of generated ideas.

According to Amabile, a good and complete model of creativity must satisfy academics and those utilizing the constructs presented in the model in the field. In order to be a complete model, it needs to "encompass existing information and integrate previous models, for at least three reasons." (Amabile, 1988, p. 124). Amabile says that an accurate and complete model prompts further research within the topic; and directs research to where the most significant gaps in the knowledge exist. A good model can also help synthesize and learn in-depth about

previously discovered concepts. Finally, a good model can promote and foster strategies that can be applied in the practice of creativity (Amabile, 1988). The enriched model of creativity that we propose attempts to do just that.

Conclusion

We contribute to the academic literature on organizational creativity. DPMC has resulted in being a model appropriate for building relationship patterns among individual components and creativity stages of the componential model of creativity. While DPMC only mentions the situational and dispositional variables that can affect creativity, the componential model provides a detailed description of what components may affect creativity throughout the different stages of the process. By offering cognitive flexibility and persistence pathways as mediators for creativity and the necessary elements that can explain the relationship between the individual components and the stages of creativity, DPMC contributes to the componential model of creativity and *vice versa* by complementing each other.

Another significant contribution is the possibility for empirical examination of creative processes within organizations since both cognitive pathways proposed are seen as mediating proxies of creativity that can be measured.

The scope of this research was looking at individual creativity; however, the componential model includes group and organizational creativity, which are essential to explore since people might display different behaviors in a group. This is a conceptual paper; empirical testing and evidence of the enriched version is needed to test individual creative potential.

CHAPTER 4

INVESTIGATING THE COMPLEXITY OF CREATIVITY: THE MEDIATING ROLE OF COGNITIVE FLEXIBILITY AND PERSISTENCE IN THE RELATIONSHIP BETWEEN PERSONALITY, AFFECT AND CREATIVITY OUTCOMES

Abstract

This study aims to investigate the associations between cognitive processes and individual components relevant for creativity by relying on the componential model of creativity and recent neuroscientific research to explore the mediating effect of cognitive flexibility and persistence on creativity outcomes. Data from participants in simulations of Alternative Uses Task (AUT) and routine tasks were analyzed by partial least square-structural modeling (PLS-SEM). Results show creativity outcomes are formed by personality and affect, consistent with findings in previous literature. Surprisingly, neither the direct effect of cognitive flexibility and persistence on creativity outcomes nor the mediating effect of these two cognitive constructs on the personality-creativity and affect-creativity relationship were found to be significant, which suggests a more complex than expected relationship of the cognitive processes with the generation of creative outcomes. This research also highlights the need for further and finer studies into the valid measurements of the cognitive pathways in order to be able to see their full effect on creativity. This study contributes to a more in-depth understanding of the process of creativity and the underlying cognitive mechanisms

Introduction

Creativity is a concept that has been appearing throughout literature and research in many disciplines and important for day-to-day human activities, as well, as competitive advantage and progress in terms of organizational success (Bisbe & Malaguenõ, 2015; Hughes et al., 2018; Madrid et al., 2019). Since creativity is essential for problem-solving, especially those problems that are not the easiest to solve, and stands for the generation of novel and useful ideas – it has shown to be of great importance for those companies striving for new products and processes, as well as attempting to facilitate strategies for creative progress (Amabile & Pratt, 2016b).

Creativity is shown to be a dynamic process that develops through different stages, with the outcome being a creative idea that is novel and considered helpful by others (Amabile, 1988b; Amabile & Pratt, 2016b). According to research, different components affect the process of creativity in various ways depending on the stage (Acar et al., 2019; van Knippenberg, 2017). One of the most validated organizational frameworks of creativity is the componential model of creativity that places importance on creativity-relevant skills, domain expertise, and motivation components to influence the process of creativity through the different stages of creative idea generation and creative problem-solving (Amabile, 1988b; Amabile & Pratt, 2016b). Amabile and Pratt (2016) pointed to the necessity of a dynamic perspective in the understanding of the creative process, particularly by "focusing (…) on the individual-level psychological processes implicated in creativity" (Amabile & Pratt, 2016b, p. 1). While the relevance of the psychological antecedents related to creativity and innovation processes has been largely discussed, paradoxically, organizational and management literature shows a vast gap when it comes to researching them.

(Amabile, 1983a, 1988a, 1996; Hirst et al., 2009; Runco & Acar, 2012; Van Knippenberg et al., 2004).

Recent neuroscientific research has pointed towards the importance of cognitive flexibility and persistence as individual cognitive processes responsible for dynamically influencing creative idea generation (Nijstad et al., 2010b). Cognitive flexibility has shown to be an essential influence on creative thinking and has been associated with the functional connectivity between brain networks related to creative thinking – Default Mode Network and Executive Control Network (Boot et al., 2017; Chrysikou, 2019; Khalil et al., 2019; Zabelina & Andrews-Hanna, 2016). People that engage in creative tasks switch between two modes of thinking, one associated with a more flexible pattern of thinking and diffused attention and the other one showing a more focused and detailed attention, persistently dedicated to the task in hand (Amer et al., 2016b; Beaty et al., 2016b; K. C. Fox & Beaty, 2019; Khalil et al., 2019). Switching between flexible and persistent states of mind according to the task requirements is essential for creative idea generation (Benedek & Fink, 2019; Boot et al., 2017; Di Domenico & Ryan, 2017; Gu et al., 2018).

We see two gaps in the literature that we attempt to tackle: (1) the relationship between the two cognitive pathways and creativity processes and (2) the influence of dispositional and situational variables, such as personality and affect, on cognitive flexibility and cognitive persistence.

Despite the evidence for the importance of cognitive flexibility and persistence in creative processes, the relationship between these two cognitive pathways with creativity has not been explored to its extent (Wu & Koutstaal, 2020b). However, efforts have been made to measure the cognitive processes out of lab context to make it applicable in organizational

settings. For instance, recent research has proposed assessment techniques to measure the dynamic switches between cognitive flexibility and persistence when engaged in creative tasks (Wu & Koutstaal, 2020b).

Evidence has shown that individuals affected by different situational or dispositional variables, such as personality traits and affect, will activate either the cognitive flexibility or cognitive persistence pathway (Nijstad et al., 2010b; Wu & Koutstaal, 2020b). Individuals seem to do so to reach the creative idea generation outcome; however, the influence of these variables on cognitive flexibility and persistence has not been explored (Nijstad et al., 2010b; Wu & Koutstaal, 2020b).

In order to tackle these gaps, we undertake an empirical exploration of the role played by cognitive processes into the individual components-creativity outcomes relationship. We utilize a recently proposed cognitive flexibility and persistence assessment in combination with well-known empirical measurements of individual factors relevant for the process of creativity (Wu & Koutstaal, 2020b). Based on a structural-equations modeling technique – Partial Least Square (PLS-SEM) –, this paper attempts to bring forth the underlying structural relationships among the key elements of creativity generation set by the componential model of creativity: individual components and creative outcomes. Therefore, this paper aims to explore the mediation effect of cognitive persistence and cognitive flexibility on the influence of individual components (personality and affect) on creativity outcomes. The PLS-SEM technique apprehends and shows the deep structural relationships and interactions between complex constructs, such as those involved in creativity. Following previous works, we introduce the Self-Guided Transition technique to measure the two pathways (Wu & Koutstaal, 2020a). This technique is based on a simple process of counting switches between creative and routine tasks, which makes it

appropriate to be used in organizational settings where traditional neuropsychological measurement methods are not accessible (Wu & Koutstaal, 2020a).

Since both a theoretical and a methodological – measurement – gap within the association of individual components and creative outcomes were identified, our research proposed to tackle these gaps. There is the possibility for the potential use of these cognitive pathways as both conceptual mediators and feasible measurement proxies for the process of creativity. Taking this into account, our paper's objective is to explore to what extent neuropsychological phenomena usually measured by neuroimaging methods related to creativity can be assessed within the organizational setting by the use of regular resources.

Individual components of creativity in organisations

The componential model of creativity, that was developed by Amabile is the foundation for this research and it shows the dynamic process of creativity through various stages (Amabile & Pratt, 2016b). It highlights the role of three main components that can affect the process of individual creativity: domain-relevant skills (expertise and talent for the task); creativity-relevant skills (cognitive and personality abilities and traits), and task motivation which could be considered one of the most essential components since it can compensate for the lack of some others, according to Amabile. The componential model of creativity states that the more levels of these components exist, the higher will be the creative outcome, but the influence of the individual components will differ based on which stage of the creative process the individual is in. Amabile points to the intricacies of the relationships between the components themselves and the necessity to understand them to understand the process of creativity fully.

The Dual Pathway Model of Creativity (DPMC) is a neuropsychological model that explores the process of creativity from neuropsychological and socio-psychological lenses. DPMC identifies two distinct cognitive processes – cognitive flexibility and cognitive persistence – that contribute to creative thinking. Both cognitive pathways come from neuroscientific research. Cognitive flexibility refers to the ability to switch between ideas and is characterized by mind-wandering, while persistence pathway shows undivided attention to the task and filtering out distracting stimuli. DPMC talks about situational and dispositional factors that affect creativity via each or both cognitive pathways, those factors including cognitive processes and personality traits, as well as the situational context (Nijstad et al., 2010a).

We chose components that made up the wider 'creativity-relevant skills' that are composed of different dispositional factors influencing individual creativity.

These factors are also relevant in the Dual Pathway Model of Creativity (DPMC), and they enable cognitive flexibility or persistence pathway or a combination of both and influence individual creativity (Nijstad et al., 2010b).

We decided to start from personality and affect, with both concepts widely used in organizational literature. Their relevance is discussed for companies and organizational success in various aspects, e.g., the leader's personality or the personality of employees or of those that make up a team, as well as the individual mood that employees encounter while working on different tasks. Both components have been mentioned in Amabile's componential model of individual creativity, with personality appearing since the beginning and affect being the new addition in one of the newest updates to the model – dynamic creativity (Amabile & Pratt, 2016b) .

Personality

Personality differences have been shown to be relevant for work performance, success, engagement within the task and the job itself of the employees, as well the overall job satisfaction (Neal et al., 2012; Smallfield & Kluemper, 2021; Young et al., 2018). Research has pointed out the relevance of personality traits with participating in activities that require creativity (F Barron & Harrington, 2003; Feist, 1998a). Out of the Big 5 Personality characteristics, openness to experience is the one that is most correlated with creativity. Openness to experience has shown to be positively correlated with adaptability to different working environments, as well engaging in tasks that require creative input (Neal et al., 2012). Openness to experience is followed by extraversion (Feist, 2019; Gocłowska et al., 2019; Jauk, 2019; Jauk et al., 2014; Perkins et al., 2015; Puryear et al., 2017). Extraversion closely follows after openness to experience by showing a higher association with creative potential (Puryear et al. 2017). Agreeableness, conscientiousness, and neuroticism show inconclusive results (Feist, 2019). High levels of agreeableness and neuroticism appeared to hinder the creative-innovative process in some instances (Puryear et al. 2017). Some studies revealed that a lower score on the agreeableness scale promotes creative thought when the situational context around the individual is against novelty and new experiences, while other studies find a very low association with agreeableness in general (Feist 2019). Similar discrepancies were shown when exploring the relationship between conscientiousness and creativity and neuroticism and creativity (Feist 2019).

Neuroscientific research also points towards the positive relationship between personality and cognitive flexibility (Mussel et al., 2015; Nijstad et al., 2010b). According to DPMC, openness to experience specifically has been associated with thoughts processes that explore

multiple ideas at the same time (Mussel et al. 2015), showing a positive relationship with cognitive flexibility (Baas Matthijs et al., 2011; Feist, 2019; Nijstad et al., 2010b).

Positive and Negative Affect

Both positive and negative affect have also been shown to have a positive relationship with individual creativity (Amabile & Pratt, 2016b). DPMC has pointed toward positive affect related to cognitive flexibility and cognitive persistence related to negative affect (Khalil et al., 2019; Nijstad et al., 2010b). Affect plays a vital role in the organizational context as an essential element for "positive job-related outcomes" (Madrid et al., 2014, p. 248). The dynamic componential model specifies that creativity strongly relates to affect; and engaging in purposeful work, influencing creativity-relevant skills (Amabile & Pratt, 2016). According to the componential model, positive affect has been positively associated with creativity, with negative and ambivalent affect having an indirect positive effect on creativity (Amabile & Pratt, 2016). DPMC shows that positive mood can increase cognitive flexibility and negative mood can increase persistence (Khalil et al., 2019; Nijstad et al., 2010).

Methods.

Participants

Participants (N = 54) were graduate and undergraduate students at a Spanish private business school. Every participant had to meet the inclusion criteria of proficiency in English, having normal or corrected-to-normal vision and hearing. The participants took part in the research in return for personality test results if they asked for it and/or extra credit.

Process measures.

Big Five Inventory (BFI). To measure personality, we utilized the Big Five Personality Inventory (Arterberry et al., 2014). BFI is an assessment that includes 44 items across five different scales that correspond to the Big Five Personality Model: Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. The BFI has 10 items that correspond to the Openness to Experience item; 9 items for Conscientiousness; 8 items that correspond to the Extraversion item, 9 items for Agreeableness and 8 items for Neuroticism. Participants were presented with a questionnaire which they had to read and respond according to a 5-point Likert scale that ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). This scale is one of the most widespread psychometric measurements of personality tests and has shown satisfactory scores for reliability, validity and other measurements that have made it popular among researchers as has been evidenced by a variety of literature (Arterberry et al., 2014).

Positive and Negative Affect Schedule We tested affect with the Positive and Negative Affect Schedule (PANAS) scale which is one of the most widely used psychometric scales for assessment of positive and negative affect that has shown both validity and reliability between cultures, language and populations (Díaz-García et al., 2020). The original scale includes 10 positive affect and 10 negative affect items, the total of 20 items on the PANAS scale. The positive affect items include words such as “enthusiastic,” “alert,” “inspired,” and the negative affect items included words like “stressed,” “scared”, and “hostile.” The items are rated on a Likert scale from 1 “strongly disagree” to 5 “strongly agree.” The scale that was presented in our simulation was in English language however, it has been previously translated and validated in a variety of other languages with high internal consistency results (Díaz-García et al., 2020).

Self-Guided Transitions. The technique used to assess cognitive flexibility and persistence measures the two cognitive pathways in a more natural setting where participants take part in creative and routine tasks and freely choose to work on one or the other creative or routine problem during an allocated time (Wu & Koutstaal, 2020b). The measurement used is the recently developed technique called Self-Guided Transitions that allows the measure of shifting count between tasks and dwelling times on each separate task, signifying cognitive flexibility and persistence (Wu & Koutstaal, 2020b). In comparison with other creative tasks measuring switches and transitions (Wu & Koutstaal, 2020b), the control techniques that take care of the experimental design don't allow for natural conditions found in daily creative problems and, therefore, cannot be generalized to tasks that are present in organizational settings. Another reason for why Self-Guided Transitions was chosen in comparison with other measurements for cognitive flexibility and persistence is because research has shown that the results in tasks in voluntary task-switching paradigms produce less error percentages in comparison to those paradigms where a switch is indicated beforehand (e.g. forced) (Wu & Koutstaal, 2020b).

Self-Guided Transitions is also a paradigm that allows to count for the amount of switching times signifying cognitive flexibility, as well as dwelling times showing persistence, in comparison to other creativity tasks like Alternative Uses Task where voluntary switches can be inferred, but not measured, as well as the amount of time participants spend per task which Self-Guided Transitions do take into an account. The task was also previously assessed for the relationship between cognitive flexibility and creativity via the association between the results on diverse traditional creativity tasks and the results on the Self-Guided Transitions and allowed to measure the traditional outcomes of creative tasks, such as fluency originality and others, as well as the shift and the dwell count, at the same time. (Wu & Koutstaal, 2020b).

Voluntary task switching with similar aims for each of the tasks also accounts for the individual components that are important for the process of creativity within an organizational context and presupposes the involvement of different "cognitive, perceptual, and motivational" constructs in order to participate in creative tasks and achieve creative idea generation outcomes (Nijstad et al., 2010a; Wu & Koutstaal, 2020a). Indeed, the authors that developed the Self-Guided Transitions indicated the importance of potential contributors to the process of creativity and attempted to gather metacognitive information that could influence voluntary switches signifying cognitive flexibility or persistence.

Study design

This was a within and between subject design. The participants were administered a series of psychometric scales prior to the creativity and routine tasks, specifically the Big Five Personality Inventory (Arterberry et al., 2014), the Positive and Negative Affect Scale (Díaz-García et al., 2020). Participants also completed perceptual and conceptual tasks that we report to be the "(1) Alternative Uses Task" and (2) Routine Task. For the participants to be familiarized with the way the AUT functions they were first given one item to practice on before they moved on to the two-item paradigm for the Self-Guided Transitions test. Table 1 provides examples of the task stimuli for the AUT and the Routine Task that were used in the SGT paradigm.

Table 1.

Task	**Examples**	**Number of Items**	**Duration**
Alternative	Two-set: Blanket, Flashlight	2	10 minutes

Uses Task			
Routine task	1. There are about 795 apartments in this building complex. The average family size is 6 people. There are about _____ people living in the building complex. **a. 4,800 b. 5,000 c. 5,500** 1. The average fare on the bus is $2.50. If there were 89,125 passengers last Saturday and 349,124 passengers last Sunday, the city train received about _____ more last Sunday. **a. $260,000 b. $520,000 c. $650,000**	2	10 minutes

Procedure.

Participants were tested altogether in different testing sessions. The sessions began with making sure that the participants understood and signed the informed consent and any questions were answered. At the conclusion of each of the sessions, participants were thanked and debriefed.

Pilot study. To test the study, 3 pre-test sessions were conducted with a total number of 24 participants. Technical difficulties that were observed during the test were fixed for the actual procedure (premature closing of the simulation, error windows).

Participants were presented with two different simulations on two different excel files, one for the AUT simulation and the other for the routine task simulation. Each of the simulations had two different tasks that the participants had the choice to complete. After reading the instructions for the task that appeared on the main page of the Excel sheet for both of the simulations, participants were instructed to click the "Start" button. As soon as the Start button was clicked, participants are taken to the first task (in the case of AUT, the task where they have to come up with alternative uses for the word "blanket"; and in the case of the routine task, the first set of the seven arithmetic questions they have to answer. The participants, then, freely choose whether they work on Task 1 (blanket and the first set of seven arithmetic questions) or Task 2 (flashlight and the second set of seven arithmetic questions). In order to switch they have to click on the "Task 2" button on the Task 1 page, and on the "Task 1" button on the Task 2 page. They are able to finish at any time by clicking the "Finish" button; otherwise, the simulation will finish by itself after ten minutes.

The Excel simulation records how much time each of the participants works on each of the tasks at any given times, when the switches are made, and the number of switches made per experiment. The time spent on any given task will signify the "dwelling," and the switches will signify the "shifting". Shift count is calculated as the number of times each of the participants freely chose to work on the other task item by clicking the appropriate button provided by the simulation, as well as the total amount spent on the simulation minus the dwelling time. The total "dwell" length was calculated by totaling the time the participants chose to spend at any given

tasks at any given time during the experiment. The participants also record their answers in a box for each experiment so that the results for both AUT and routine tasks can be assessed post-experiment. This approach allows for assessing the continuous progress of the participant throughout the experiment, according to time, and measuring the exact number of responses provided by the total shift count and the dwell length for each of the tasks.

Alternative Uses Task (Part of the Self-Guided Transitions simulation) In order to measure creativity outcomes, we utilized the Alternative Uses Task, which is a well-known test on divergent thinking that has been used to test creativity in a variety of literature (Wu & Koutstaal, 2020b). In this task participants are given different simple items and they have to come up with different uses for these items in a time constraint. The test wants the participants to come up with various ideas that are both novel and useful and, therefore, approximates measuring for creativity. The results are then assessed across four different categories: fluency (number of different uses for the simple items), originality (how novel the uses are in comparison to other participants), flexibility (the use of the alternative uses across different categories) and elaboration (how developed the alternative use was) (Wu & Koutstaal, 2020b). This task is different to other traditionally routine tasks that are not considered creative and require one solution to a problem we are presented with, which do not require to have creative thinking or predispositions to creativity. For this task we use the routine task where participants have to solve a series of easy mathematical problems that would only have one correct solution. This type of routine task has been shown in organizational literature to signify daily routine activities that can be found within job settings (Price, 2020). Participants were presented with two different items: blanket and flashlight, as two different options on an Excel sheet. They had to choose alternative uses for each of the items, as many as they could think of. Participants were measured

for various aspects based on their results in the AUT task: fluency, originality; scored 0,1 or 2 – where 2 represented responses that were considered to be exceptionally novel), flexibility, and elaboration, similar to other studies (Wu & Koutstaal, 2020a). The creativity tasks were assessed and scored anonymously by two independent evaluators unaware of our research hypotheses. Each of the raters was given instructions on how to score the creative performance results in order to have sufficient inter-rater reliability; the results of the inter-rater reliability are shown in Table 2.

Routine task. (Part of the Self-Guided Transitions simulation) Participants were presented with two sets of seven arithmetic questions, presented as two different tasks on an Excel sheet. Each of the total 14 arithmetic questions only had one possible correct solution which the participants had to approximate and choose from the provided list of multiple-choice options.

Inter-rater reliability:

We calculated the inter-rater reliability with Cohen's weighted kappa, a coefficient that measures the rater agreement between different raters on nominal or ordinal scales. The weighted kappa considered the degrees of disagreement since the participants' answers and the rater's judgments were very subjective. Another reason for using the weighted kappa is because this study utilizes a meaningful order of the rating categories (0 is less than 1, and 1 is less than 2). The inter-rater reliability was calculated between the AUT task's flexibility, fluency, originality, and elaboration measurements. Ratings between 0.01 and 0.20 signify slight agreement and go up after that, with >0.21 signifying fair agreement,> 0.41 moderate agreement, and >0.61 substantial agreement (Cohen, 1960, 1968; Landis & Koch, 1977).

Table 2. Cohen's weighted kappa

Ratings	Weighted kappa
CO_ELABORATION_R1 - CO_ELABORATION_R2	0.110
CO_FLEXIBILITY_R1 - CO_FLEXIBILITY_R2	0.648
CO_ORIGINALITY_R1 - CO_ORIGINALITY_R2	0.351
CO_FLUENCY_R1 - CO_FLUENCY_R2	0.284

Note. 51 subjects/items and 2 raters/measurements.

The results point to different levels of agreement among the invited raters. Flexibility has substantial agreement and suggests a strong consensus between the raters with originality having a moderate agreement, and elaboration and fluency having a fair agreement level between the raters.

When talking about treating data, generally, the ratings of both raters can be used from moderate to substantial agreement because the two raters are mostly consistent with their answers. In this paper, the flexibility measure, as well as the originality measure, have passed those criteria. There are considerable differences in elaboration and fluency scores between the two raters, therefore, in this case the use of two raters is necessary since the results of inter-reliability analysis is not as consistent as the flexibility and the originality scores. The decision to use data from a single rater has been previously used when there is moderate to substantial

analysis, such as the case for flexibility and originality (Cicchetti, 1994; Landis & Koch, 1977)(Cicchetti, 1994; Landis & Koch, 1977). Therefore, as a consequence, we have used the data from one of the raters for flexibility and originality scores and two raters for elaboration and fluency scores.

Data Analysis

The data obtained from the participants was processed with the PLS-SEM technique (Smart PLS software, version 3.2.8) (Hair, Sarstedt, et al., 2014; Sarstedt et al., 2021). The reason for choosing PLS-SEM was because this technique allows the exploration of complex constructs and reflects the interaction between obtained data and the theory behind the data (Henseler et al., 2015; Sarstedt et al., 2021). Processing data with PLS-SEM provides a prediction vs. confirmation, which is thought after both in academia and in practice. It allows showing the relationships between different variables and the constructs with its measurement model and shows interrelations that are structural models via ordinary least square regressions (Hair, Sarstedt, et al., 2014; Sarstedt et al., 2021) . It does so by calculating the construct values based on the variables and then checking for the reliability and validity of the measurement model it provides (Henseler et al., 2015). Afterward, it calculates path coefficients between these constructures that make part of the structural model (Hair, Sarstedt, et al., 2014; Sarstedt et al., 2021). The third step of the PLS-SEM is bootstrapping, which tests inferential statistics. This study ran the bootstrapping procedure with 5,000 re-samples and the percentile bootstrap at the 95% confidence interval for both of the models it ran (Sarstedt et al., 2021). This particular model was assessed by the use of path coefficients, R^2 of endogenous variables, and the standardized root mean square residual (SRMR) (Kock & Lynn, 2012).

Table 2.

Construct	Variables	Measure
Creativity Outcomes	**Originality**	The scores that the rater gave to the AUT during the Self-Guided Transitions where participants had to provide alternative uses for two items (blanket & flashlight)
	Fluency	
	Elaboration	
	Flexibility	
Cognitive Flexibility	**Cognitive Flexibility AUT**	The amount of switches per task in the AUT & the routine task simulations
	Cognitive Flexibility Routine Task	
Cognitive Persistence	**Cognitive Persistence AUT**	The amount of time participants spent per task in AUT and Routine Task

	Cognitive Persistence **Routine Task**	simulations
Personality	**Openness to Experience, ,**	The Scores on the Big 5 Inventory
	Conscientiousness	
	Extraversion,	
	Agreeableness,	
	Neuroticism	
Affect	**Positive Affect**	The scores on the Positive and Negative Affect Scale
	Negative Affect	

The structural model without the mediating effects of the two cognitive pathways is presented in Figure 1, and the structural model with the mediating effects is presented in Figure 2. Both are reflective measurement models since they presuppose that the latent construct causes the observed variables or indicators (Fornell & Larcker, 1981; Gefen et al., 2000; Hair, Jr., et al., 2014). Since it is a reflective model, the underlying latent constructs (Personality, Creativity outcomes, Affect, Cognitive Flexibility, and Cognitive Persistence) indicate the observed variables with the arrows pointing from the construct (Fornell & Larcker, 1981; Gefen et al., 2000; Hair, Jr., et al., 2014). In the case of personality, for example, the five factors are

considered to be lower-order factors that measure the personality construct. The indicators will, therefore, have a strong relationship with one another and reflect the underlying construct (Fornell & Larcker, 1981; Gefen et al., 2000; Hair, Jr., et al., 2014). The latent construct is then supposed to be caused by the observed variables (Fornell & Larcker, 1981; Gefen et al., 2000; Hair, Jr., et al., 2014). This model presupposes that the indicators are a good way of measuring the construct that is attempted to be observed (Fornell & Larcker, 1981; Gefen et al., 2000; Hair, Jr., et al., 2014).

Figure 1. Structural model without the mediating effects

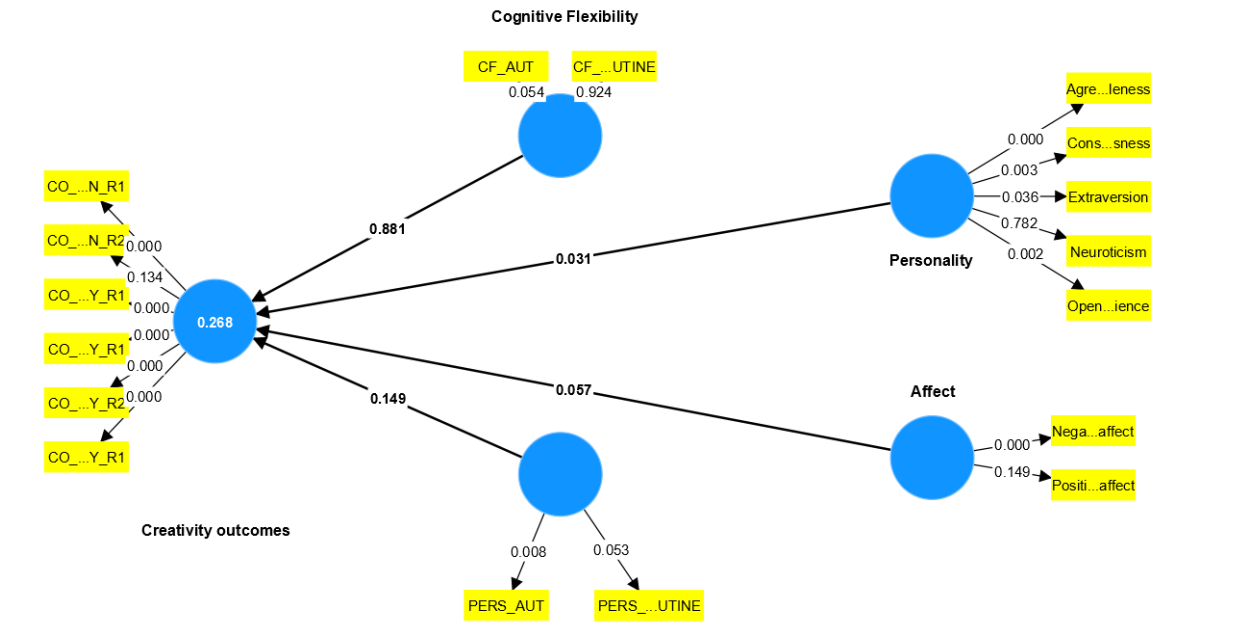
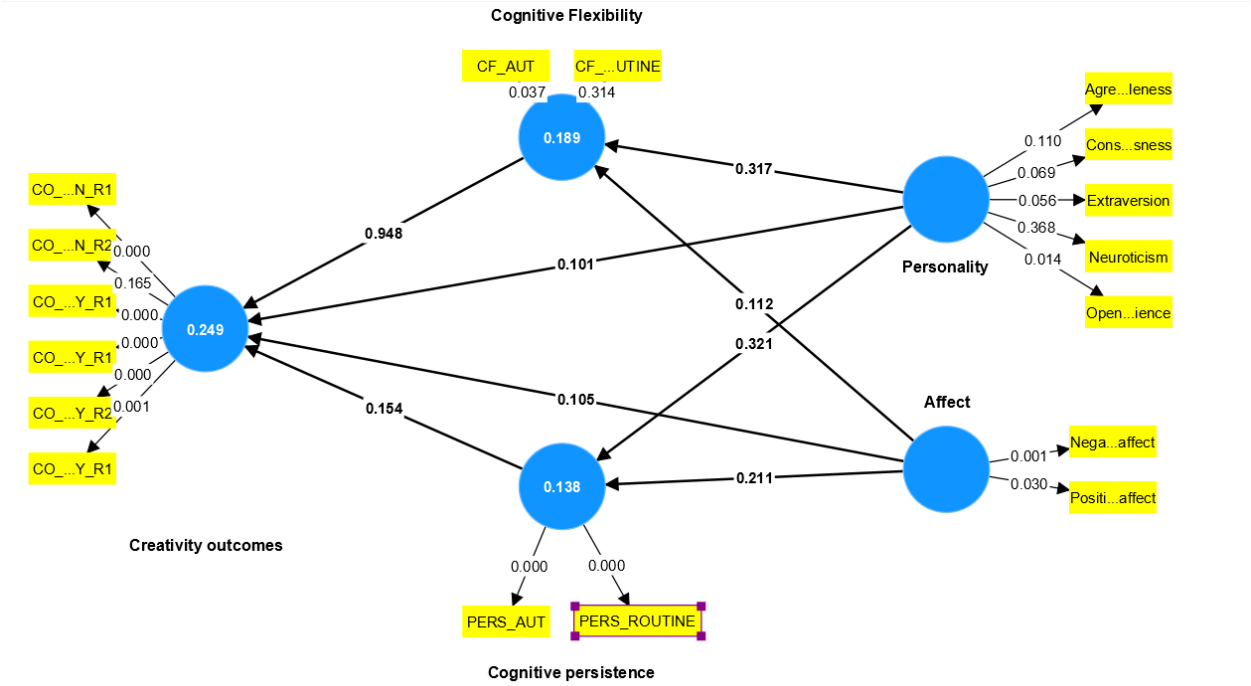


Figure 2. Structural model with the mediating effects



Results

Validity and reliability of the measurement models

External validity was not measured for this study because no additional measurements were available for any of the constructs presented within the study through the reflective variables (Kock, 2015). Since it is reflective, internal consistency and convergent validity worked as validation measurements for this study (Nitzl et al., 2016). Nonetheless, multicollinearity was tested via the variance inflation factor (VIF) technique that resulted in values below the cut-off of 3, which showed that the multicollinearity or the possibility that it would be difficult to assess the individual effect of each of the indicators on the latent variables did not threaten the validity of the latent variables and their indicators for the model without mediating effects and with the mediating effects (Table 3, 4). (Hair et al., 2011) The determinants' weights were also significant, showing that the determinants could explain the

majority of the variance in each of the constructs for both models (Table 3, 4) (Kock, 2014, 2015).

Table 3. Measurement model without mediating effects.

Construct	Variable	VIF	Weight
Cognitive Flexibility	**Cognitive Flexibility AUT**	1.006	1.001
	Cognitive Flexibility Routine Task	1.006	-0.135
Cognitive Persistence	**Cognitive Persistence AUT**	1.294	0.687
	Cognitive Persistence Routine Task	1.294	0.469
Creativity Outcomes	**Rater 1: Elaboration**	2.004	0.260

	Rater 2: Elaboration	1.544	0.073
	Rater 1: Fluency	6.370	0.232
	Rater 2: Fluency	5.544	0.281
	Rater 1: Flexibility	3.379	0.161
	Rater 1: Originality	1.328	0.344
Personality	**Openness to Experience**	1.176	0.379
	Conscientiousness	1.360	0.275
	Extraversion	1.217	0.202
	Agreeableness	1.442	0.527
	Neuroticism	1.048	-0.089
Affect	**Positive Affect**	1.078	0.236
	Negative Affect	1.078	0.910

Table 4. Measurement model with mediating effects of cognitive flexibility and cognitive persistence.

Construct	Variable	VIF	Weight
Cognitive Flexibility	**Cognitive Flexibility AUT**	**1.006**	**0.870**
	Cognitive Flexibility Routine Task	**1.006**	**0.431**
Cognitive Persistence	**Cognitive Persistence AUT**	**1.294**	**0.581**
	Cognitive Persistence Routine Task	**1.294**	**0.583**
Creativity Outcomes	**Rater 1: Elaboration**	2.004	0.284
	Rater 2: Elaboration	1.544	0.044
	Rater 1: Fluency	6.370	0.244

	Rater 2: Fluency	5.544	0.282
	Rater 1: Flexibility	3.379	0.172
	Rater 1: Originality	1.328	0.295
Personality	**Openness to Experience**	1.176	0.420
	Conscientiousness	1.360	0.343
	Extraversion	1.217	0.456
	Agreeableness	1.442	0.084
	Neuroticism	1.048	-0.432
Affect	**Positive Affect**	1.078	0.531
	Negative Affect	1.078	0.717

Structural model and mediation analysis

The estimation of the structural model without mediating effects resulted in almost significant direct effect of affect on creativity outcomes with a *p-value* of **0.057**, as well as a significant direct effect of personality on creativity outcomes with a *p-value* of **0.031,** however with a non-significant direct effect of cognitive flexibility and cognitive persistence on creativity outcomes with *p-values* of **0.881** and **0.149** respectively (Table 5, Figure 1).

The measurement was insignificant when attempting to estimate the structural model with indirect effects of personality and affect via the mediating effect of cognitive flexibility and persistence on creativity outcomes. For example, the structural model with the mediating effects resulted in a non-significant direct effect of cognitive flexibility on creativity outcomes with a *p-value* of **0.948** and a non-significant direct effect of cognitive persistence on creativity outcomes with a *p-value* of **0.154.** Personality has resulted in a non-significant indirect effect on creativity outcomes with a *p-value* of **0.561,** a non-significant direct effect on cognitive flexibility with a *p-value* of **0.310,** a non-significant direct effect on cognitive persistence with a *p-value* of **0.282**. Affect, has resulted in an almost significant indirect effect on creativity outcomes with a p-value of **0.494** when the *p-value* for significance cut-off is at **0.05** and a non-significant direct effect on cognitive flexibility with a *p-value* of **0.375;** and a non-significant direct effect on cognitive persistence with a *p-value* of **0.293** (Table 6, Figure 2).

Table 5. Structural model without the mediating effects

Effects on endogenous variables	Direct effects (path coefficient)	*t*-value (bootstrap)	Percentile 97% confidence intervals
Creativity outcomes			
Cognitive flexibility	0.881	0.149	0.338
Cognitive persistence	0.149	1.444	0.393

Personality	0.031	2.161	0.594
Affect	0.057	1.900	0.076

Table 6. Structural model with the mediating effects

Effects on endogenous variables	Direct effects (path coefficient)	*t*-value (bootstrap)	Percentile 97% confidence intervals
Creativity outcomes			
Cognitive flexibility	0.866	0.168	0.520
Cognitive persistence	0.217	1.233	0.509
Personality	Personality -> Cognitive Flexibility: 0.310	Personality -> Cognitive Flexibility: 1.015	Personality -> Cognitive Flexibility: 0.632
	Personality -> Cognitive persistence: 0.282	Personality -> Cognitive persistence: 1.076	Personality -> Cognitive persistence 0.602

Affect	Affect -> Cognitive Flexibility: 0.375	Affect -> Cognitive Flexibility: 0.888	Affect -> Cognitive Flexibility: 0.484
	Affect -> Cognitive persistence: 0.293	Affect -> Cognitive persistence: 1.051	Affect -> Cognitive persistence 0.095

Discussion

In line with extensive prior research, our study showcases the important influence of individual components, specifically, personality traits and affect, on creativity outcomes (Amabile, 1983a, 1988a; Amabile & Pratt, 2016a; F Barron & Harrington, 2003; Feist, 1998a, 2010). This aligns with the research and various theoretical frameworks regarding creativity and creativity outcomes (Csikszentmihalyi, 1998; Sternberg & Lubart, 2014). While our findings did not reveal a significant relationship between cognitive flexibility, persistence, and creativity outcomes, it is essential to view these results in a broader context and understand the multifaceted relationship between cognitive pathways and creativity. These findings point to the possibility that the impact the cognitive pathways have on creativity outcomes might be contingent upon the specificity of different creative tasks in hand, and it is important to highlight that the cognitive pathways are still integral to the process of creativity.

Based on our results and previous literature, it is essential to note that they are not the only cognitive processes responsible for successful creative outcomes. Indeed, research points to a complex relationship between cognitive flexibility, persistence, and creativity outcomes. For example, many studies emphasize the relevance of other factors apart from the cognitive pathways relevant to the process of creativity and just the cognitive processes cannot predict creative outcomes by themselves (Glăveanu & Kaufman, 2019; J. C. Kaufman & Baer, 2012; Silvia et al., 2009). For example, Kaufman et al. (2017) found that cognitive persistence is involved in the creative process, however, the results varied depending on whether the measurements were self-reported or not. Recent study showed that individuals who considered persistence as important as a result of previous training were able to improve their creativity and that persistence itself was mediated by the amount of time the participants spent on the task which suggests other confounding variables could be play when speaking regarding the effect of cognitive persistence on creativity (Toyama et al., 2023). Other factors should be considered in regards with creativity outcomes, such that had been mentioned before in prominent models of creativity – domain expertise, motivation, the nature of the creative activity etc. (Amabile, 1996; Plucker & Beghetto, 2006; Silvia et al., 2009). Individual components do not produce creative outcomes by themselves, and the intricacies in the relationship between them is something that has been shown to be relevant to research in the literature (Amabile, 1983a, 1988a; Amabile & Pratt, 2016a; Nijstad et al., 2010a). One such example is shown in the DPMC. The DPMC model says that both situational and dispositional factors play a role in creative outcomes, therefore, the situational context should also be taken into account in combination with individual components. Creativity is a neuropsychological process since it is influenced and involves the interaction of different processes, including those that are cognitive, affective and motivational. Despite that,

one might say that it is also attitudinal in nature, since openness to experience and risk-taking requires to be open to new ideas in order to engage in them. This study plays an important role for opening the path to understanding this intricate interplay between cognitive pathways and creativity and opens an avenue for future research that can consider various contributing factors.

Conclusion, limitations, and future research.

In conclusion, this study explored the intricacies of the relationship between cognitive processes, such as cognitive flexibility and persistence, and individual components (personality traits and affect) and their effect on creative outcomes. The findings suggested a multifaceted and complex relationship that is not straightforward. For example, the results provided by this study present a complexity of the relationship and association between cognitive flexibility and creativity. A more nuanced exploration of cognitive flexibility and other components included in the present study is needed for further understanding of their effect on creative outcomes.

Despite that, it is also possible that this study could not thoroughly apprehend the intricacies of the association between cognitive pathways and creativity outcomes. It can suggest that this association is more intricate. Many studies have found a positive relationship between cognitive flexibility and creativity, pointing to its importance for creativity (Beaty et al., 2015, 2016a, 2017; Dietrich & Kanso, 2010; Fink & Benedek, 2014). Cognitive persistence also positively correlates with creativity in different studies (Silvia et al., 2008).

The path to measuring creativity is still very obscure, and calculating the switch counts and dwell amount has shown to be correlated by other studies; however, more research needs to be done in order to learn the intricacies of measuring cognitive flexibility and persistence and

their effect on creativity; as well as the influence of individual components on cognitive flexibility and persistence (Beaty et al., 2014; Benedek & Neubauer, 2013)(Beaty et al., 2014; Benedek & Neubauer, 2013). Switching count and dwelling times, while showing cognitive flexibility and persistence, might not explain the full manifestation of the cognitive pathways in creative tasks (Beaty et al., 2014; Benedek, Jauk, Fink, et al., 2014; Benedek, Jauk, Sommer, et al., 2014; Benedek, Schickel, et al., 2014). The results provided in this study explain that this relationship between cognitive pathways and creativity is not straightforward, and the measurements that exist today might not be able to capture the cognitive processes fully.

This study highlights the importance of empirically examining the measurement of both cognitive pathways in natural settings and their relationship with creativity outcomes (Dietrich & Kanso, 2010). This concurs with the theory (Wu & Koutstaal, 2020a) suggesting that creative tasks elicit a higher activation of the cognitive flexibility and persistence pathways than routine tasks. Indeed, according to neuroscientific research, the two cognitive pathways have to work together for the brain areas related to creativity to activate (Beaty & Silvia, 2012) . Routine tasks, on the other hand, do not elicit as high of activation of cognitive flexibility or cognitive persistence.

It would be beneficial to continue studying different measures of cognitive flexibility and persistence and see the effect of the individual components on them, including those of motivation, domain expertise, and others relevant to the creativity process. This study is relevant for future research on creativity in various ways. Considering the non-significant result of the relationship between cognitive flexibility and persistence with the creativity outcomes can highlight the importance of not placing absolute value on the relevance of the cognitive pathways in all types of creative tasks. Future studies should focus on and explore the differences in

cognitive flexibility and persistence depending on the creative task presented to the participants. Apart from that, the study highlights the need to study more valid measurements of cognitive flexibility and persistence regarding their relationship with creativity. Future studies can utilize this study to create a more holistic understanding of the creativity process and the underlying cognitive mechanisms that affect it. Different approaches can be undertaken to study the influence of individual components on cognitive flexibility and persistence. The use of experimental designs can be useful for manipulating the cognitive process to see how their effect on creativity process and outcomes. Apart from that, various correlational studies can be done to see associations between specific individual components and cognitive flexibility and persistence and hypothesize their relevance in predicting creative outcomes. Other factors in the componential model of creativity, such as motivation, domain expertise, and others, should also be included in further studies (Amabile, 1988).

The findings of this study and other future research are relevant for application to real-world settings, including those within the organizational and management contexts. This study points to the relevance of individual differences that should be considered within the workplace. Managers can switch between autonomy and flexibility depending on the employee's predispositions, with some needing more structure and rigorousness, as well as step-by-step guides, and others requiring more independent work time. More research should also be conducted within companies to test the real-world applications in natural settings of how the cognitive pathways interact with creativity outcomes and the role that the individual components play. To summarize, the research on exploring the intricacies of the relationship of cognitive processes and individual components and their influence on creative outcomes is contributing to a better understanding of the multifaceted construct of creativity.

DISCUSSION

The goal of this doctoral dissertation was the broad increase and deepening of understanding of the concept of individual creativity within organizations. While focusing on individual creativity, this thesis still emphasizes the importance and interconnectedness between the individual level of creativity and group and organizational levels of creativity that must be explored further in future research.

The main findings of this dissertation aim to address a variety of gaps introduced in the beginning through the different results presented through the compilation of three academic papers that were worked on throughout the thesis. The thesis aimed at differentiating creativity and innovation, which was addressed in the systematic literature review – this conceptual differentiation set the stage for further exploration in subsequent papers. It explored both concepts and concluded that creativity and innovation are distinct concepts and processes that require separate analysis and research exploration while still mentioning their interconnectedness within research and practice. The first paper concludes with creativity coming before innovation, a necessary step for innovation, and encompasses the generation of novel and useful ideas. In contrast, innovation brings in the implementation of those creative ideas. This concept of differentiation is crucial for academia and organizations that intend to foster creativity and innovation within their internal processes to gain a competitive advantage.

The thesis also further explored the individual-level creativity process by looking at the neuropsychological components that contribute to the process of creativity. As explored in the second paper pertaining to the dissertation, it based its findings on the systematic literature

review. It added to the body of knowledge by providing an enriched model of creativity. It proposed two cognitive pathways coming from a neuropsychological DPMC model into the componential model of creativity. Cognitive flexibility and persistence were proposed as mediators for the individual components of creativity that influenced the creativity process. Combining neuropsychological evidence with organizational evidence attempted to show a more holistic approach to studying the process of creativity and serve as a foundational framework for further exploring creativity on group and organizational levels.

Finally, the thesis attempted to provide an empirical examination of the conceptual factors and elements that were discussed in the second paper and provide guidance for how future researchers may address the topic of the process of empirical analysis – something that has been insisted on by a variety of researchers in this area. This empirical examination paper highlighted the importance of personality traits and affect, as well as cognitive flexibility and persistence, on the process of creativity and creativity outcomes and provided an avenue for future researchers to explore the empirical examination of individual variables about the creativity process.

The logical thread that connects the three papers within this dissertation develops a journey through the intricacies of the creativity process within the organizational context. The progression from the first to the third paper is structured in a way that it addresses the gaps in the theoretical understanding of creativity and deepens the exploration of the factors relevant to its dynamic process. The first paper, a systematic literature review, begins the journey by highlighting the fundamental discrepancies in the conceptualization of creativity and innovation, acknowledges the theoretical gap in the consensus of their definitions in the literature, and

clarifies the distinction between the concepts based on a thorough analysis of the literature. This paper integrates the insights from neuropsychology and sets the stage for subsequent papers while emphasizing the relevance of individual psychological components necessary in the study of creativity. The first paper of this dissertation addresses the debate of defining creativity and innovation by highlighting the discrepancies in the conceptualization of creativity and innovation and clarifies the distinction between these concepts. Apart from that, it helps in the understanding of individual psychological components in researching individual creativity and sets the stage to explore these individual-level factors further. Further, it also integrates knowledge coming from neuropsychology, the debate that was presented in the introduction with the lack of bridging management studies and neuropsychology and the need to bring these two fields closer together.

The second paper builds upon the foundation laid out by the literature review and acknowledges the dynamism of the process of creativity by developing an enriched model of creativity that integrates the componential model and the dual-pathway models of creativity and acknowledges cognitive flexibility and persistence as potential mediators of creativity. It also showcases the relevance of other individual components and cognitive processes that influence creativity. The second paper directly solves the debate upon the foundation that was built with the literature review and provides an enriched model of creativity via exploring the individual factors relating to creativity further. It also directly solves the debate of bridging neuropsychology and management by bringing in knowledge from a neuropsychological model in the form of cognitive flexibility and persistence pathways into the organizational model of creativity.

The third paper builds from the second paper and puts it into action through empirical examination while attempting to address the methodological limitations and gaps. It attempts to measure cognitive flexibility and persistence influence on creativity outcomes. It also provides a unique insight into how individual components such as personality traits and affect influence creativity and deepens the investigation into the process of creativity by adding to the theoretical components explored in the previous papers. The third paper contributes significantly to the debate regarding the empirical examination of the model of individual creativity, precisely how cognitive flexibility, persistence, personality traits, and affect influence creativity outcomes. It increases the theoretical understanding of individual creativity in organizations. By empirically examining cognitive flexibility and persistence's influence on individual creativity, it also explores the role of neuropsychological processes in the management context.

These three papers form a logical thread that begins with showcasing the distinction between creativity and innovation, moving onto the enriched model and culminating in an empirical examination of the theoretical underpinnings discussed beforehand. Management literature has not considered neuropsychological contributions within its research for the most part, perhaps, because the methods used in neuropsychological research are vastly different from the ones used in management literature (Baas et al., 2008; Beaty et al., 2014; Dietrich & Kanso, 2010; Gong et al., 2009). Apart from that, the methods used in neuropsychological research aid in the theoretical understanding of creativity and individual processes, but they have not been considered practical for organizations that hope to facilitate creativity (Baas et al., 2008; Beaty et al., 2014; Dietrich & Kanso, 2010; Gong et al., 2009)(Baas et al., 2008; Beaty et al., 2014; Dietrich & Kanso, 2010; Gong et al., 2009). This dissertation proves that we can theoretically identify these neuropsychological concepts, and we can join the two worlds; apart from that, it

provides a possible way to utilize neuroscientific findings empirically within the management world to some extent. This dissertation opens the door for management researchers to implement more empirical studies to further the academic knowledge of n the topic. Together, the three papers add to the body of knowledge and recognition of creativity as a multifaceted concept that is essential for competitive advantage in organizations, that is influenced by many individual neuropsychological components (e.g. personality, affect, motivation etc.), and that can be measured. Organizations can utilize the insights provided in this dissertation to foster tailored strategies that increase creativity within their companies, and researchers can utilize the knowledge for future exploration of group and organizational levels of creativity, as well as delving deeper within the individual level of creativity, theoretically and empirically.

Future research can build upon these insights and continue the exploration to foster creativity on individual, group, and organizational levels within organizations both theoretically and empirically and further explore neuroscientific findings that can be implemented within organizational literature and utilize neuropsychological methods to study creativity.

Bibliography

Abraham, A. (2013). The promises and perils of the neuroscience of creativity. *Frontiers in Human Neuroscience*, *MAY*. https://doi.org/10.3389/fnhum.2013.00246

Acar, O. A., Tarakci, M., & van Knippenberg, D. (2019). Creativity and Innovation Under Constraints: A Cross-Disciplinary Integrative Review. *Journal of Management*, 1–26. https://doi.org/10.1177/0149206318805832

Amabile, T. M. (1983a). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, *45*(2). https://doi.org/10.1037/0022-3514.45.2.357

Amabile, T. M. (1983b). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*. https://doi.org/10.1037/0022-3514.45.2.357

Amabile, T. M. (1988a). A Model of Creativity and Innovation in Organizations. In *Research in Organizational Behavior* (Vol. 10, Issue 1).

Amabile, T. M. (1988b). A Model of Creativity and Innovation in Organizations. In *Research in Organizational Behavior*. https://doi.org/Article

Amabile, T. M. (1996). Creativity in Context: Update to the Social Psychology of Creativity (Boulder, CO. *Westview Press.Baer, J.(1998).The Case for Domain Specificity of Creativity.Creativity Research Journal*, *11*.

Amabile, T. M. (1997). Entrepreneurial creativity through motivational synergy. *Journal of Creative Behavior*, *31*(1). https://doi.org/10.1002/j.2162-6057.1997.tb00778.x

Amabile, T. M. (2017). *In Pursuit of Everyday Creativity*. https://doi.org/10.1002/jocb.200

Amabile, T. M., Barsade, S. G., Mueller, J. S., & Staw, B. M. (2005). Affect and creativity at work. *Administrative Science Quarterly*, *50*(3). https://doi.org/10.2189/asqu.2005.50.3.367

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the Work Environment for Creativity. *Academy of Management Journal*, *39*(5). https://doi.org/10.5465/256995

Amabile, T. M., & Pillemer, J. (2012). Perspectives on the social psychology of creativity. In *Journal of Creative Behavior*. https://doi.org/10.1002/jocb.001

Amabile, T. M., & Pratt, M. G. (2016a). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. In *Research in Organizational Behavior* (Vol. 36). https://doi.org/10.1016/j.riob.2016.10.001

Amabile, T. M., & Pratt, M. G. (2016b). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. In *Research in Organizational Behavior* (Vol. 36, pp. 157–183). JAI Press. https://doi.org/10.1016/j.riob.2016.10.001

Amer, T., Campbell, K. L., & Hasher, L. (2016a). Cognitive Control As a Double-Edged Sword. In *Trends in Cognitive Sciences* (Vol. 20, Issue 12). https://doi.org/10.1016/j.tics.2016.10.002

Amer, T., Campbell, K. L., & Hasher, L. (2016b). Cognitive Control As a Double-Edged Sword. In *Trends in Cognitive Sciences* (pp. 905–915). https://doi.org/10.1016/j.tics.2016.10.002

Anderson, N., Potočnik, K., & Zhou, J. (2014). Innovation and Creativity in Organizations: A State-of-the-Science Review, Prospective Commentary, and Guiding Framework. In *Journal of Management* (Vol. 40, Issue 5). https://doi.org/10.1177/0149206314527128

Andrews-Hanna, J. R., Reidler, J. S., Huang, C., & Buckner, R. L. (2010). Evidence for the default network's role in spontaneous cognition. *Journal of Neurophysiology*, *104*(1). https://doi.org/10.1152/jn.00830.2009

Andriole, S. J. (2020). Innovation, Emerging Technology, and Digital Transformation. *IT Professional*, *22*(4), 69–72. https://doi.org/10.1109/MITP.2020.2985491

Arden, R., Chavez, R. S., Grazioplene, R., & Jung, R. E. (2010). Neuroimaging creativity: A psychometric view. In *Behavioural Brain Research* (Vol. 214, Issue 2). https://doi.org/10.1016/j.bbr.2010.05.015

Arterberry, B. J., Martens, M. P., Cadigan, J. M., & Rohrer, D. (2014). Application of generalizability theory to the big five inventory. *Personality and Individual Differences*. https://doi.org/10.1016/j.paid.2014.05.015

Baas, M., De Dreu, C. K. W., & Nijstad, B. A. (2008). A Meta-Analysis of 25 Years of Mood-Creativity Research: Hedonic Tone, Activation, or Regulatory Focus? *Psychological Bulletin*, *134*(6). https://doi.org/10.1037/a0012815

Baas, M., Nevicka, B., & Ten Velden, F. S. (2020). When paying attention pays off: the mindfulness skill act with awareness promotes creative idea generation in groups. *European Journal of Work and Organizational Psychology*. https://doi.org/10.1080/1359432X.2020.1727889

Baas, M., Roskes, M., Sligte, D., Nijstad, B. A., & De Dreu, C. K. W. (2013). Personality and creativity: The dual pathway to creativity model and a research agenda. *Social and Personality Psychology Compass*. https://doi.org/10.1111/spc3.12062

Baas Matthijs, M., De Dreu, C. K. W., & Nijstad, B. A. (2011). When Prevention Promotes Creativity: The Role of Mood, Regulatory Focus, and Regulatory Closure. *Journal of Personality and Social Psychology*. https://doi.org/10.1037/a0022981

Baer, J. (1998). The case for domain specificity of creativity. *Creativity Research Journal*, *11*(2). https://doi.org/10.1207/s15326934crj1102_7

Baer, J. (2012). Domain specificity and the limits of creativity theory. In *Journal of Creative Behavior* (Vol. 46, Issue 1). https://doi.org/10.1002/jocb.002

Baer, J., & Kaufman, J. C. (2008). Gender differences in creativity. In *Journal of Creative Behavior* (Vol. 42, Issue 2). https://doi.org/10.1002/j.2162-6057.2008.tb01289.x

Baer, J., Kaufman, J. C., & Gentile, C. A. (2004). Extension of the Consensual Assessment Technique to Nonparallel Creative Products. *Creativity Research Journal*, *16*(1). https://doi.org/10.1207/s15326934crj1601_11

Baer, M., Dane, E., & Madrid, H. (2020). Zoning out or Breaking Through? Linking Daydreaming to Creativity in the Workplace. *Academy of Management Journal*. https://doi.org/10.5465/amj.2017.1283

Baer, M., & Oldham, G. R. (2006). The curvilinear relation between experienced creative time pressure and creativity: Moderating effects of openness to experience and support for creativity. *Journal of Applied Psychology*, *91*(4). https://doi.org/10.1037/0021-9010.91.4.963

Beaty, R. E., Benedek, M., Barry Kaufman, S., & Silvia, P. J. (2015). Default and Executive Network Coupling Supports Creative Idea Production. *Scientific Reports*, *5*. https://doi.org/10.1038/srep10964

Beaty, R. E., Benedek, M., Silvia, P. J., & Schacter, D. L. (2016a). Creative Cognition and Brain Network Dynamics. In *Trends in Cognitive Sciences* (Vol. 20, Issue 2). https://doi.org/10.1016/j.tics.2015.10.004

Beaty, R. E., Benedek, M., Silvia, P. J., & Schacter, D. L. (2016b). Creative Cognition and Brain Network Dynamics. In *Trends in Cognitive Sciences* (pp. 87–95). https://doi.org/10.1016/j.tics.2015.10.004

Beaty, R. E., Benedek, M., Wilkins, R. W., Jauk, E., Fink, A., Silvia, P. J., Hodges, D. A., Koschutnig, K., & Neubauer, A. C. (2014). Creativity and the default network: A functional connectivity analysis of the creative brain at rest. *Neuropsychologia*, *64*. https://doi.org/10.1016/j.neuropsychologia.2014.09.019

Beaty, R. E., Seli, P., & Schacter, D. L. (2019). Network neuroscience of creative cognition: mapping cognitive mechanisms and individual differences in the creative brain. In *Current Opinion in Behavioral Sciences* (pp. 22–30). https://doi.org/10.1016/j.cobeha.2018.08.013

Beaty, R. E., & Silvia, P. J. (2012). Why do ideas get more creative across time? An executive interpretation of the serial order effect in divergent thinking tasks. *Psychology of Aesthetics, Creativity, and the Arts*, *6*(4). https://doi.org/10.1037/a0029171

Beaty, R. E., Silvia, P. J., & Benedek, M. (2017). Brain networks underlying novel metaphor production. *Brain and Cognition*, *111*. https://doi.org/10.1016/j.bandc.2016.12.004

Benedek, M., & Fink, A. (2019). Toward a neurocognitive framework of creative cognition: the role of memory, attention, and cognitive control. In *Current Opinion in Behavioral Sciences* (pp. 116–122). https://doi.org/10.1016/j.cobeha.2018.11.002

Benedek, M., Jauk, E., Fink, A., Koschutnig, K., Reishofer, G., Ebner, F., & Neubauer, A. C. (2014). To create or to recall? Neural mechanisms underlying the generation of creative new ideas. *NeuroImage*, *88*. https://doi.org/10.1016/j.neuroimage.2013.11.021

Benedek, M., Jauk, E., Sommer, M., Arendasy, M., & Neubauer, A. C. (2014). Intelligence, creativity, and cognitive control: The common and differential involvement of executive functions in intelligence and creativity. *Intelligence*, *46*(1), 73–83. https://doi.org/10.1016/J.INTELL.2014.05.007

Benedek, M., & Neubauer, A. C. (2013). Revisiting mednick's model on creativity-related differences in associative hierarchies. Evidence for a common path to uncommon thought. *Journal of Creative Behavior*, *47*(4). https://doi.org/10.1002/jocb.35

Benedek, M., Schickel, R. J., Jauk, E., Fink, A., & Neubauer, A. C. (2014). Alpha power increases in right parietal cortex reflects focused internal attention. *Neuropsychologia*, *56*(1). https://doi.org/10.1016/j.neuropsychologia.2014.02.010

Bisbe, J., & Malaguenõ, R. (2015). How control systems influence product innovation processes: Examining the role of entrepreneurial orientation. *Accounting and Business Research*, *45*(3), 356–386. https://doi.org/10.1080/00014788.2015.1009870

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, *84*(6). https://doi.org/10.1002/1098-237X(200011)84:6<740::AID-SCE4>3.0.CO;2-3

Bledow, R., Frese, M., Anderson, N., Erez, M., & Farr, J. (2009). A Dialectic Perspective on Innovation: Conflicting Demands, Multiple Pathways, and Ambidexterity. *Industrial and Organizational Psychology*, *2*(3). https://doi.org/10.1111/j.1754-9434.2009.01154.x

Boccia, M., Barbetti, S., Piccardi, L., Guariglia, C., Ferlazzo, F., Giannini, A. M., & Zaidel, D. W. (2016). Where does brain neural activation in aesthetic responses to visual art occur? Meta-analytic evidence from neuroimaging studies. In *Neuroscience and Biobehavioral Reviews* (Vol. 60). https://doi.org/10.1016/j.neubiorev.2015.09.009

Boccia, M., Piccardi, L., Palermo, L., Nori, R., & Palmiero, M. (2015). Where do bright ideas occur in ourbrain? Meta-analytic evidence from neuroimaging studies of domain-specific creativity. *Frontiers in Psychology*, *6*(AUG), 155624. https://doi.org/10.3389/FPSYG.2015.01195/BIBTEX

Boden, M. A. (2003). The creative mind: Myths and mechanisms: Second edition. In *The Creative Mind: Myths and Mechanisms: Second Edition*. https://doi.org/10.4324/9780203508527

Bodla, A. A., Tang, N., Jiang, W., & Tian, L. (2018). Diversity and creativity in cross-national teams: The role of team knowledge sharing and inclusive climate. *Journal of Management and Organization*, *24*(5), 711–729. https://doi.org/10.1017/jmo.2016.34

Boot, N., Baas, M., van Gaal, S., Cools, R., & De Dreu, C. K. W. (2017). Creative cognition and dopaminergic modulation of fronto-striatal networks: Integrative review and research agenda. In *Neuroscience and Biobehavioral Reviews* (pp. 13–23). https://doi.org/10.1016/j.neubiorev.2017.04.007

Campbell, D. T. (1960). Blind variation and selective retentions in creative thought as in other knowledge processes. *Psychological Review*, *67*(6). https://doi.org/10.1037/h0040373

Carson, S. H., Peterson, J. B., & Higgins, D. M. (2005). Reliability, validity, and factor structure of the creative achievement questionnaire. *Creativity Research Journal*, *17*(1). https://doi.org/10.1207/s15326934crj1701_4

Cavalcanti, D. R., Oliveira, T., & de Oliveira Santini, F. (2022). Drivers of digital transformation adoption: A weight and meta-analysis. *Heliyon*, *8*(2). https://doi.org/10.1016/j.heliyon.2022.e08911

Christensen, B. T., & Schunn, C. D. (2007). The relationship of analogical distance to analogical function and preinventive structure: The case of engineering design. *Memory and Cognition*, *35*(1). https://doi.org/10.3758/BF03195939

Chrysikou, E. G. (2019). Creativity in and out of (cognitive) control. In *Current Opinion in Behavioral Sciences* (pp. 94–99). https://doi.org/10.1016/j.cobeha.2018.09.014

Chrysikou, E. G., & Thompson-Schill, S. L. (2011). Dissociable brain states linked to common and creative object use. *Human Brain Mapping*, *32*(4). https://doi.org/10.1002/hbm.21056

Cicchetti, D. V. (1994). Guidelines, Criteria, and Rules of Thumb for Evaluating Normed and Standardized Assessment Instruments in Psychology. *Psychological Assessment*, *6*(4). https://doi.org/10.1037/1040-3590.6.4.284

Cohen, J. (1960). A Coefficient of Agreement for Nominal Scales. *Educational and Psychological Measurement*, *20*(1). https://doi.org/10.1177/001316446002000104

Cohen, J. (1968). Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychological Bulletin*, *70*(4), 213–220. https://doi.org/10.1037/H0026256

Colzato, L. S., Ozturk, A., & Hommel, B. (2012). Meditate to create: The impact of focused-attention and open-monitoring training on convergent and divergent thinking. *Frontiers in Psychology*, *3*(APR). https://doi.org/10.3389/fpsyg.2012.00116

Colzato, L. S., Van Wouwe, N. C., Lavender, T. J., & Hommel, B. (2006). Intelligence and cognitive flexibility: Fluid intelligence correlates with feature "unbinding" across perception and action. *Psychonomic Bulletin and Review*. https://doi.org/10.3758/BF03213923

Cropley, A. (2006). In praise of convergent thinking. In *Creativity Research Journal* (Vol. 18, Issue 3). https://doi.org/10.1207/s15326934crj1803_13

Csikszentmihalyi, M. (1998). *Creativity: Flow and the Psychology of Discovery and Invention - ProQuest*. Personnel Psycology.

Csikszentmihalyi, M. (2014). Society, Culture, and Person: A Systems View of Creativity. In *The Systems Model of Creativity*. https://doi.org/10.1007/978-94-017-9085-7_4

De Jong, J., & Den Hartog, D. (2010). Measuring innovative work behaviour. *Creativity and Innovation Management*, *19*(1). https://doi.org/10.1111/j.1467-8691.2010.00547.x

De Pisapia, N., Bacci, F., Parrott, D., & Melcher, D. (2016). Brain networks for visual creativity: a functional connectivity study of planning a visual artwork. *Scientific Reports*, *6*. https://doi.org/10.1038/SREP39185

Deci, E. L., & Ryan, R. M. (1985). Intrinsic Motivation and Self-Determination in Human Behavior. In *Intrinsic Motivation and Self-Determination in Human Behavior*. https://doi.org/10.1007/978-1-4899-2271-7

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*, *49*(3). https://doi.org/10.1037/a0012801

Dewett, T. (2007). Linking intrinsic motivation, risk taking, and employee creativity in an R&D environment. *R and D Management*, *37*(3). https://doi.org/10.1111/j.1467-9310.2007.00469.x

Di Domenico, S. I., & Ryan, R. M. (2017). The emerging neuroscience of intrinsic motivation: A new frontier in self-determination research. In *Frontiers in Human Neuroscience* (p. 13). https://doi.org/10.3389/fnhum.2017.00145

Díaz-García, A., González-Robles, A., Mor, S., Mira, A., Quero, S., García-Palacios, A., Baños, R. M., & Botella, C. (2020). Positive and Negative Affect Schedule (PANAS): Psychometric properties of the online Spanish version in a clinical sample with emotional disorders. *BMC Psychiatry*, *20*(1). https://doi.org/10.1186/s12888-020-2472-1

Dietrich, A. (2004). The cognitive neuroscience of creativity. *Psychonomic Bulletin and Review*, *11*(6). https://doi.org/10.3758/BF03196731

Dietrich, A. (2007). Who's afraid of a cognitive neuroscience of creativity? *Methods*, *42*(1). https://doi.org/10.1016/j.ymeth.2006.12.009

Dietrich, A. (2019). Where in the brain is creativity: a brief account of a wild-goose chase. In *Current Opinion in Behavioral Sciences*. https://doi.org/10.1016/j.cobeha.2018.09.001

Dietrich, A., & Haider, H. (2015). Human creativity, evolutionary algorithms, and predictive representations: The mechanics of thought trials. In *Psychonomic Bulletin and Review* (Vol. 22, Issue 4). https://doi.org/10.3758/s13423-014-0743-x

Dietrich, A., & Kanso, R. (2010). A review of EEG, ERP, and neuroimaging studies of creativity and insight. *Psychological Bulletin*, *136*(5). https://doi.org/10.1037/a0019749

Dijksterhuis, A., & Meurs, T. (2006). Where creativity resides: The generative power of unconscious thought. *Consciousness and Cognition*, *15*(1). https://doi.org/10.1016/j.concog.2005.04.007

Dollinger, S. J., & Shafran, M. (2005). Note on consensual assessment technique in creativity research. In *Perceptual and Motor Skills* (Vol. 100, Issue 3 I). https://doi.org/10.2466/PMS.100.3.592-598

Drazin, R., Glynn, M. A., & Kazanjian, R. K. (1999). Multilevel theorizing about creativity in organizations: A sensemaking perspective. In *Academy of Management Review* (Vol. 24, Issue 2). https://doi.org/10.5465/AMR.1999.1893937

Eisenberger, R., & Shanock, L. (2003). Rewards, Intrinsic Motivation, and Creativity: A Case Study of Conceptual and Methodological Isolation. In *Creativity Research Journal* (Vol. 15, Issues 2–3). https://doi.org/10.1207/s15326934crj152&3_02

Ekvall, G. (1997). Organizational Conditions and Levels of Creativity. *Creativity and Innovation Management*, *6*(4). https://doi.org/10.1111/1467-8691.00070

Ellamil, M., Dobson, C., Beeman, M., & Christoff, K. (2012). Evaluative and generative modes of thought during the creative process. *NeuroImage*, *59*(2). https://doi.org/10.1016/j.neuroimage.2011.08.008

F Barron, and, & Harrington, D. M. (2003). Creativity, Intelligence, and Personality. *Https://Doi.Org/10.1146/Annurev.Ps.32.020181.002255*, *32*(1), 439–476. https://doi.org/10.1146/ANNUREV.PS.32.020181.002255

Fave, A. D., & Massimini, F. (2012). The relevance of subjective well-being to social policies: Optimal experience and tailored intervention. In *The Science of Well-Being*. https://doi.org/10.1093/acprof:oso/9780198567523.003.0015

Feist, G. J. (1998a). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*, *2*(4). https://doi.org/10.1207/s15327957pspr0204_5

Feist, G. J. (1998b). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*. https://doi.org/10.1207/s15327957pspr0204_5

Feist, G. J. (2010). #6 The Function of Personality in Creativity. The Nature and Nurture of the Creative Personality. In *The Cambridge Handbook of Creativity* (Vol. 1, Issue 1 999).

Feist, G. J. (2019). Creativity and the Big Two model of personality: plasticity and stability. In *Current Opinion in Behavioral Sciences* (pp. 31–35). https://doi.org/10.1016/j.cobeha.2018.07.005

Fink, A., & Benedek, M. (2014). EEG alpha power and creative ideation. In *Neuroscience and Biobehavioral Reviews* (Vol. 44). https://doi.org/10.1016/j.neubiorev.2012.12.002

Fink, A., & Neubauer, A. C. (2006). EEG alpha oscillations during the performance of verbal creativity tasks: Differential effects of sex and verbal intelligence. *International Journal of Psychophysiology*, *62*(1). https://doi.org/10.1016/j.ijpsycho.2006.01.001

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, *18*(1). https://doi.org/10.1177/002224378101800104

Fox, K. C., & Beaty, R. E. (2019). Mind-wandering as creative thinking: neural, psychological, and theoretical considerations. In *Current Opinion in Behavioral Sciences*. https://doi.org/10.1016/j.cobeha.2018.10.009

Fox, K. C. R., Andrews-Hanna, J. R., Mills, C., Dixon, M. L., Markovic, J., Thompson, E., & Christoff, K. (2018). Affective neuroscience of self-generated thought. In *Annals of the New York Academy of Sciences* (Vol. 1426, Issue 1). https://doi.org/10.1111/nyas.13740

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*(4). https://doi.org/10.1002/job.322

Gajda, A., Karwowski, M., & Beghetto, R. A. (2017). Creativity and academic achievement: A meta-analysis. *Journal of Educational Psychology*, *109*(2). https://doi.org/10.1037/edu0000133

Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice. *Communications of the Association for Information Systems*, *4*. https://doi.org/10.17705/1cais.00407

George, J. M., & Zhou, J. (2007). Dual tuning in a supportive context: Joint contributions of positive mood, negative mood, and supervisory behaviors to employee creativity. *Academy of Management Journal*, *50*(3). https://doi.org/10.5465/AMJ.2007.25525934

Gerhart, B., & Fang, M. (2015). Pay, Intrinsic Motivation, Extrinsic Motivation, Performance, and Creativity in the Workplace: Revisiting Long-Held Beliefs. *Annual Review of Organizational Psychology and Organizational Behavior*. https://doi.org/10.1146/annurev-orgpsych-032414-111418

Gilhooly, K. J., Fioratou, E., Anthony, S. H., & Wynn, V. (2007). Divergent thinking: Strategies and executive involvement in generating novel uses for familiar objects. *British Journal of Psychology*, *98*(4). https://doi.org/10.1348/096317907X173421

Glăveanu, V. P. (2010a). Paradigms in the study of creativity: Introducing the perspective of cultural psychology. *New Ideas in Psychology*, *28*(1). https://doi.org/10.1016/j.newideapsych.2009.07.007

Glăveanu, V. P. (2010b). Principles for a cultural psychology of creativity. *Culture and Psychology*, *16*(2). https://doi.org/10.1177/1354067X10361394

Glăveanu, V. P. (2013). Rewriting the language of creativity: The five A's framework. *Review of General Psychology*, *17*(1). https://doi.org/10.1037/a0029528

Glăveanu, V. P. (2020). A Sociocultural Theory of Creativity: Bridging the Social, the Material, and the Psychological. *Review of General Psychology*, *24*(4). https://doi.org/10.1177/1089268020961763

Glăveanu, V. P., & Kaufman, J. C. (2019). Creativity: A historical perspective. In *The Cambridge Handbook of Creativity: Second Edition*.

Gocłowska, M. A., Ritter, S. M., Elliot, A. J., & Baas, M. (2019). Novelty seeking is linked to openness and extraversion, and can lead to greater creative performance. *Journal of Personality*. https://doi.org/10.1111/jopy.12387

Gong, Y., Huang, J. C., & Farh, J. L. (2009). Employee learning orientation, transformational leadership, and employee creativity: The mediating role of employee creative self-efficacy. *Academy of Management Journal*, *52*(4). https://doi.org/10.5465/AMJ.2009.43670890

Good, D. J., Lyddy, C. J., Glomb, T. M., Bono, J. E., Brown, K. W., Duffy, M. K., Baer, R. A., Brewer, J. A., & Lazar, S. W. (2016). Contemplating Mindfulness at Work: An Integrative Review. *Journal of Management*, *42*(1). https://doi.org/10.1177/0149206315617003

Grant, A. M. (2012). Leading with meaning: Beneficiary contact, prosocial impact, and the performance effects of transformational leadership. *Academy of Management Journal*, *55*(2). https://doi.org/10.5465/amj.2010.0588

Green, A. E., Cohen, M. S., Raab, H. A., Yedibalian, C. G., & Gray, J. R. (2015). Frontopolar activity and connectivity support dynamic conscious augmentation of creative state. *Human Brain Mapping*, *36*(3). https://doi.org/10.1002/hbm.22676

Green, B. N., Johnson, C. D., & Adams, A. (2006). Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. *Journal of Chiropractic Medicine*. https://doi.org/10.1016/S0899-3467(07)60142-6

Gu, S., Gao, M., Yan, Y., Wang, F., Tang, Y., & Huang, J. H. (2018). The Neural Mechanism Underlying Cognitive and Emotional Processes in Creativity. *Frontiers in Psychology*, *9*, 1924. https://doi.org/10.3389/fpsyg.2018.01924

Guilford, J. P. (1950). Creativity. *American Psychologist*, *5*(9), 444–454. https://doi.org/10.1037/H0063487

Guilford, J. P. (1959a). Three faces of intellect. *American Psychologist*, *14*(8). https://doi.org/10.1037/h0046827

Guilford, J. P. (1959b). Traits of creativity. In *Creativity: selected readings*.

Guilford, J. P. (1968). Creativity, intelligence and their educational implications. In *Null: Vol. null*.

Gupta, R., & Banerjee, P. (2016). Antecedents of organisational creativity: A multi-level approach. *Business: Theory and Practice*, *17*(2), 167–177. https://doi.org/10.3846/btp.2016.624

Hair, J. F., Jr., H. G. T. M., Ringle, C. M., & Sarstedt, M. (2014). A primer on partial least squares structural equations modeling (PLS-SEM). Sage Publications. *Journal of Tourism Research*, *6*(2).

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2). https://doi.org/10.2753/MTP1069-6679190202

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. In *European Business Review* (Vol. 26, Issue 2). https://doi.org/10.1108/EBR-10-2013-0128

Hargadon, A. B., & Bechky, B. A. (2006). When collections of creatives become creative collectives: A field study of problem solving at work. In *Organization Science* (Vol. 17, Issue 4). https://doi.org/10.1287/orsc.1060.0200

Hargadon, A., & Sutton, R. I. (1997). Technology brokering and innovation in a product development firm. *Administrative Science Quarterly*, *42*(4). https://doi.org/10.2307/2393655

Heilman, K. M. (2016). Possible brain mechanisms of creativity. In *Archives of Clinical Neuropsychology* (pp. 285–296). https://doi.org/10.1093/arclin/acw009

Hekman, D. R., Johnson, S. K., Foo, M. Der, & Yang, W. (2017). Does diversity-valuing behavior result in diminished performance ratings for non-white and female leaders? *Academy of Management Journal*, *60*(2). https://doi.org/10.5465/amj.2014.0538

Hektner, J. M. , S. J. A. , & C. M. (2007). *Experience sampling method: Measuring the quality of everyday life.* Sage Publications, Inc.

Hennessey, B. A. (2000). Self-determination theory and the social psychology of creativity. *Psychological Inquiry*, *11*(4).

Hennessey, B. A., & Amabile, T. M. (2010). Creativity (2010 Annual Review of Psychology). *Annual Review of Psychology*, *61*. https://doi.org/10.1146/annurev.psych.093008.100416

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1). https://doi.org/10.1007/s11747-014-0403-8

Hernández-Torrano, D., & Ho, Y. S. (2021). A bibliometric analysis of publications in the web of science category of educational psychology in the last two decades. *Psicologia Educativa*. https://doi.org/10.5093/psed2021a19

Hirst, G., Van Knippenberg, D., & Zhou, J. (2009). A cross-level perspective on employee creativity: Goal orientation, team learning behavior, and individual creativity. *Academy of Management Journal*, *52*(2). https://doi.org/10.5465/AMJ.2009.37308035

Hogg, M. A., & Terry, D. J. (2000). Social identity and self-categorization processes in organizational contexts. *Academy of Management Review*, *25*(1). https://doi.org/10.5465/AMR.2000.2791606

Homan, A. C., Buengeler, C., Eckhoff, R. A., Van Ginkel, W. P., & Voelpel, S. C. (2015). The interplay of diversity training and diversity beliefs on team creativity in nationality diverse teams. *Journal of Applied Psychology*, *100*(5). https://doi.org/10.1037/apl0000013

Hong, L., & Page, S. E. (2001). Problem Solving by Heterogeneous Agents. *Journal of Economic Theory*, *97*(1). https://doi.org/10.1006/jeth.2000.2709

Hou, Z., Sui, Y., Song, X., & Yuan, Y. (2016). Disrupted interhemispheric synchrony in default mode network underlying the impairment of cognitive flexibility in late-onset depression. *Frontiers in Aging Neuroscience*. https://doi.org/10.3389/fnagi.2016.00230

Howard-Jones, P. A., Blakemore, S. J., Samuel, E. A., Summers, I. R., & Claxton, G. (2005). Semantic divergence and creative story generation: An fMRI investigation. *Cognitive Brain Research*, *25*(1). https://doi.org/10.1016/j.cogbrainres.2005.05.013

Hughes, D. J., Lee, A., Tian, A. W., Newman, A., & Legood, A. (2018). Leadership, creativity, and innovation: A critical review and practical recommendations. *Leadership Quarterly*, 549–569. https://doi.org/10.1016/j.leaqua.2018.03.001

Hundschell, A., Razinskas, S., Backmann, J., & Hoegl, M. (2022). The effects of diversity on creativity: A literature review and synthesis. In *Applied Psychology* (Vol. 71, Issue 4, pp. 1598–1634). John Wiley and Sons Inc. https://doi.org/10.1111/apps.12365

Hunt, E. (1994). Creative approches to cognition. Creative cognition: Theory, research and applications. R. A. Finke, T. B. Ward and S. M. Smith. Cambridge, MA: MIT Press (Bradford Books), 1992. No. of pages 240. ISBN 0-262-06150-3. Price $24.95 (Hard cover). *Applied Cognitive Psychology*, *8*(5). https://doi.org/10.1002/acp.2350080511

Jackson, S. A., & Csikszentmihalyi, M. (1999). Flow in sports: The keys to optimal experiences and performances. *Flow in Sports: The Keys to Optimal Experiences and Performances.*

Jauk, E. (2019). A bio-psycho-behavioral model of creativity. In *Current Opinion in Behavioral Sciences*. https://doi.org/10.1016/j.cobeha.2018.08.012

Jauk, E., Benedek, M., & Neubauer, A. C. (2014). The road to creative achievement: A latent variable model of ability and personality predictors. *European Journal of Personality*. https://doi.org/10.1002/per.1941

Jetten, J. , H. S. A. , & H. C. (2012). The case for a social identity analysis of health and well-being. In *The social cure: Identity, health and well-being* (pp. 3–19).

Jia, X., Li, W., & Cao, L. (2019). The role of metacognitive components in creative thinking. In *Frontiers in Psychology* (p. 2404). https://doi.org/10.3389/fpsyg.2019.02404

Jung, R. E., & Chohan, M. O. (2019). Three individual difference constructs, one converging concept: adaptive problem solving in the human brain. In *Current Opinion in Behavioral Sciences* (pp. 163–168). https://doi.org/10.1016/j.cobeha.2019.03.002

Jung, R. E., & Haier, R. J. (2007). The Parieto-Frontal Integration Theory (P-FIT) of intelligence: Converging neuroimaging evidence. In *Behavioral and Brain Sciences* (Vol. 30, Issue 2). https://doi.org/10.1017/S0140525X07001185

Jung, R. E., & Vartanian, O. (2018). The Cambridge handbook of the neuroscience of creativity. In *The Cambridge Handbook of the Neuroscience of Creativity*. https://doi.org/10.1017/9781316556238

Kandler, C., Riemann, R., Angleitner, A., Spinath, F. M., Borkenau, P., & Penke, L. (2016). The nature of creativity: The roles of genetic factors, personality traits, cognitive abilities, and environmental sources. *Journal of Personality and Social Psychology*. https://doi.org/10.1037/pspp0000087

Kasof, J. (1997). Creativity and breadth of attention. *Creativity Research Journal*, *10*(4). https://doi.org/10.1207/s15326934crj1004_2

Kaufman, J. C., & Baer, J. (2012). Beyond New and Appropriate: Who Decides What Is Creative? In *Creativity Research Journal* (Vol. 24, Issue 1). https://doi.org/10.1080/10400419.2012.649237

Kaufman, J. C., & Beghetto, R. A. (2009). Beyond Big and Little: The Four C Model of Creativity. *Review of General Psychology*, *13*(1). https://doi.org/10.1037/a0013688

Kaufman, S. B., Quilty, L. C., Grazioplene, R. G., Hirsh, J. B., Gray, J. R., Peterson, J. B., & Deyoung, C. G. (2016). Openness to Experience and Intellect Differentially Predict Creative Achievement in the Arts and Sciences. *Journal of Personality*. https://doi.org/10.1111/jopy.12156

Keller, J., & Bless, H. (2008). Flow and regulatory compatibility: An experimental approach to the flow model of intrinsic motivation. *Personality and Social Psychology Bulletin*, *34*(2). https://doi.org/10.1177/0146167207310026

Kenett, Y. N., Beaty, R. E., Silvia, P. J., Anaki, D., & Faust, M. (2016). Structure and flexibility: Investigating the relation between the structure of the mental lexicon, fluid intelligence, and creative achievement. *Psychology of Aesthetics, Creativity, and the Arts*, *10*(4). https://doi.org/10.1037/aca0000056

Kenett, Y. N., & Faust, M. (2019). A Semantic Network Cartography of the Creative Mind. In *Trends in Cognitive Sciences*. https://doi.org/10.1016/j.tics.2019.01.007

Khalil, R., Godde, B., & Karim, A. A. (2019). The link between creativity, cognition, and creative drives and underlying neural mechanisms. In *Frontiers in Neural Circuits* (p. 15). https://doi.org/10.3389/fncir.2019.00018

Kim, J., & Song, C. (2021). The relationship between R&D team diversity and team creativity. *Management Decision*, *59*(2). https://doi.org/10.1108/MD-12-2019-1727

Kim, K. H. (2008). Meta-analyses of the relationship of creative achievement to both IQ and divergent thinking test scores. In *Journal of Creative Behavior* (Vol. 42, Issue 2). https://doi.org/10.1002/j.2162-6057.2008.tb01290.x

Kim, K. H. (2011). The Creativity Crisis: The Decrease in Creative Thinking Scores on the Torrance Tests of Creative Thinking. *Creativity Research Journal*, *23*(4). https://doi.org/10.1080/10400419.2011.627805

Kleinmintz, O. M., Ivancovsky, T., & Shamay-Tsoory, S. G. (2019). The twofold model of creativity: the neural underpinnings of the generation and evaluation of creative ideas. In *Current Opinion in Behavioral Sciences*. https://doi.org/10.1016/j.cobeha.2018.11.004

Kock, N. (2014). Advanced Mediating Effects Tests, Multi-Group Analyses, and Measurement Model Assessments in PLS-Based SEM. *International Journal of E-Collaboration*, *10*(1). https://doi.org/10.4018/ijec.2014010101

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of E-Collaboration*, *11*(4). https://doi.org/10.4018/ijec.2015100101

Kock, N., & Lynn, G. S. (2012). Lateral collinearity and misleading results in variance-based SEM: An illustration and recommendations. *Journal of the Association for Information Systems*, *13*(7). https://doi.org/10.17705/1jais.00302

Kounios, J., & Beeman, M. (2014). The cognitive neuroscience of insight. In *Annual Review of Psychology* (Vol. 65). https://doi.org/10.1146/annurev-psych-010213-115154

Kounios, J., Fleck, J. I., Green, D. L., Payne, L., Stevenson, J. L., Bowden, E. M., & Jung-Beeman, M. (2008). The origins of insight in resting-state brain activity. *Neuropsychologia*, *46*(1). https://doi.org/10.1016/j.neuropsychologia.2007.07.013

Kowatari, Y., Hee Lee, S., Yamamura, H., Nagamori, Y., Levy, P., Yamane, S., & Yamamoto, M. (2009). Neural networks involved in artistic creativity. *Human Brain Mapping*, *30*(5), 1678. https://doi.org/10.1002/HBM.20633

Kozbelt, A., Beghetto, R. A., & Runco, M. A. (2010). Theories of Creativity. *The Cambridge Handbook of Creativity*, 20–47. https://doi.org/10.1017/CBO9780511763205.004

Kraus, S., Breier, M., Lim, W. M., Dabić, M., Kumar, S., Kanbach, D., Mukherjee, D., Corvello, V., Piñeiro-Chousa, J., Liguori, E., Palacios-Marqués, D., Schiavone, F., Ferraris, A., Fernandes, C., & Ferreira, J. J. (2022). Literature reviews as independent studies: guidelines for academic practice. *Review of Managerial Science*. https://doi.org/10.1007/s11846-022-00588-8

Kucyi, A., & Davis, K. D. (2014). Dynamic functional connectivity of the default mode network tracks daydreaming. *NeuroImage*, *100*. https://doi.org/10.1016/j.neuroimage.2014.06.044

Kurtzberg, T. R., & Amabile, T. M. (2001). From Guilford to creative synergy: Opening the black box of team-level creativity. *Creativity Research Journal*, *13*(3–4). https://doi.org/10.1207/s15326934crj1334_06

Landis, J. R., & Koch, G. G. (1977). The Measurement of Observer Agreement for Categorical Data. *Biometrics*, *33*(1), 159. https://doi.org/10.2307/2529310

Laureiro-Martinez, D., Brusoni, S., Tata, A., & Zollo, M. (2019). The Manager's Notepad: Working Memory, Exploration, and Performance. *Journal of Management Studies*. https://doi.org/10.1111/joms.12528

Lin, Z., Tam, F., Churchill, N. W., Lin, F. H., MacIntosh, B. J., Schweizer, T. A., & Graham, S. J. (2021). Trail Making Test Performance Using a Touch-Sensitive Tablet: Behavioral Kinematics and Electroencephalography. *Frontiers in Human Neuroscience*. https://doi.org/10.3389/fnhum.2021.663463

Liu, S., Chow, H. M., Xu, Y., Erkkinen, M. G., Swett, K. E., Eagle, M. W., Rizik-Baer, D. A., & Braun, A. R. (2012). Neural correlates of lyrical improvisation: An fMRI study of freestyle rap. *Scientific Reports*, *2*. https://doi.org/10.1038/srep00834

Liu, S., Erkkinen, M. G., Healey, M. L., Xu, Y., Swett, K. E., Chow, H. M., & Braun, A. R. (2015). Brain activity and connectivity during poetry composition: Toward a multidimensional model of the creative process. *Human Brain Mapping*, *36*(9). https://doi.org/10.1002/hbm.22849

Lubart, T. I. (1999). "Creativity across Cultures," in R. J. Sternberg (Ed.). In *Handbook of Creativity* (pp. 339–350). Cambridge University Press.

Lubart, T. I. (2001). Models of the creative process: Past, present and future. *Creativity Research Journal*, *13*(3–4). https://doi.org/10.1207/s15326934crj1334_07

Lucchiari, C., Sala, P. M., & Vanutelli, M. E. (2018). Promoting creativity through transcranial direct current stimulation (tDCS). A critical review. In *Frontiers in Behavioral Neuroscience* (p. 11). https://doi.org/10.3389/fnbeh.2018.00167

Madrid, H. P., Niven, K., & Vasquez, C. A. (2019). Leader interpersonal emotion regulation and innovation in teams. *Journal of Occupational and Organizational Psychology*, *92*, 787–805. https://doi.org/10.1111/joop.12292

Madrid, H. P., Patterson, M. G., Birdi, K. S., Leiva, P. I., & Kausel, E. E. (2014). The role of weekly high-activated positive mood, context, and personality in innovative work behavior: A multilevel and interactional model. *Journal of Organizational Behavior*. https://doi.org/10.1002/job.1867

Marron, T. R., & Faust, M. (2019). Measuring spontaneous processes in creativity research. In *Current Opinion in Behavioral Sciences* (pp. 64–70). https://doi.org/10.1016/j.cobeha.2018.09.009

Martindale, C. (2014). Biological Bases of Creativity. In *Handbook of Creativity*. https://doi.org/10.1017/cbo9780511807916.009

Mednick, S. (1962). The associative basis of the creative process. *Psychological Review*, *69*(3). https://doi.org/10.1037/h0048850

Miller, A., & Hom, H. L. (1990). Influence of Extrinsic and Ego Incentive Value on Persistence After Failure and Continuing Motivation. *Journal of Educational Psychology*. https://doi.org/10.1037/0022-0663.82.3.539

Mirvis, P. H., & Csikszentmihalyi, M. (1991). Flow: The Psychology of Optimal Experience. *The Academy of Management Review*, *16*(3). https://doi.org/10.2307/258925

Mumford, M. D. (2003). Where Have We Been, Where Are We Going? Taking Stock in Creativity Research. In *Creativity Research Journal* (Vol. 15, Issues 2–3). https://doi.org/10.1207/s15326934crj152&3_01

Mumford, M. D., & Gustafson, S. B. (1988). Creativity Syndrome: Integration, Application, and Innovation. *Psychological Bulletin*, *103*(1). https://doi.org/10.1037/0033-2909.103.1.27

Mussel, P., Mckay, A. S., Ziegler, M., Hewig, J., & Kaufman, J. C. (2015). Predicting Creativity Based on the Facets of the Theoretical Intellect Framework. *European Journal of Personality*. https://doi.org/10.1002/per.2000

Nakamura, J., & Csikszentmihalyi, M. (2014). The concept of flow.In Flow and the foundations of positive psychology. *Springer Netherlands*.

Neal, A., Yeo, G., Koy, A., & Xiao, T. (2012). Predicting the form and direction of work role performance from the Big 5 model of personality traits. *Journal of Organizational Behavior*. https://doi.org/10.1002/job.742

Nemeth, C. J., & Staw, B. M. (1989). The Tradeoffs of Social Control and Innovation in Groups and Organizations. *Advances in Experimental Social Psychology*, *22*(C). https://doi.org/10.1016/S0065-2601(08)60308-1

Nijstad, B. A., De Dreu, C. K. W., Rietzschel, E. F., & Baas, M. (2010a). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology*, *21*(1). https://doi.org/10.1080/10463281003765323

Nijstad, B. A., De Dreu, C. K. W., Rietzschel, E. F., & Baas, M. (2010b). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology*. https://doi.org/10.1080/10463281003765323

Nijstad, B. A., Stroebe, W., & Lodewijkx, H. F. M. (2003). Production blocking and idea generation: Does blocking interfere with cognitive processes? *Journal of Experimental Social Psychology*, *39*(6). https://doi.org/10.1016/S0022-1031(03)00040-4

Nitzl, C., Roldan, J. L., & Cepeda, G. (2016). Mediation analysis in partial least squares path modelling, Helping researchers discuss more sophisticated models. *Industrial Management and Data Systems*, *116*(9). https://doi.org/10.1108/IMDS-07-2015-0302

Oldham, G. R., & Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. *Academy of Management Journal*, *39*(3). https://doi.org/10.2307/256657

Paulus, P. B. (2000). Groups, teams, and creativity: The creative potential of idea-generating groups. *Applied Psychology*, *49*(2). https://doi.org/10.1111/1464-0597.00013

Paulus, P. B., & Brown, V. R. (2007). Toward More Creative and Innovative Group Idea Generation: A Cognitive-Social-Motivational Perspective of Brainstorming. *Social and Personality Psychology Compass*, *1*(1). https://doi.org/10.1111/j.1751-9004.2007.00006.x

Paulus, P. B., & Brown, V. R. (2010). Enhancing Ideational Creativity in Groups: Lessons from Research on Brainstorming. In *Group Creativity: Innovation through Collaboration*. https://doi.org/10.1093/acprof:oso/9780195147308.003.0006

Paulus, P. B., & Nijstad, B. A. (2003). Group creativity: common themes and future directions. *Group Creativity: Innovation through Collaboration*.

Perkins, A. M., Arnone, D., Smallwood, J., & Mobbs, D. (2015). Thinking too much: Self-generated thought as the engine of neuroticism. In *Trends in Cognitive Sciences*. https://doi.org/10.1016/j.tics.2015.07.003

Perry-Smith, J. E., & Mannucci, P. V. (2017). From creativity to innovation: The social network drivers of the four phases of the idea journey. *Academy of Management Review*. https://doi.org/10.5465/amr.2014.0462

Perry-Smith, J. E., & Shalley, C. E. (2003). The social side of creativity: A static and dynamic social network perspective. *Academy of Management Review*, *28*(1). https://doi.org/10.5465/AMR.2003.8925236

Plucker, J. A., & Beghetto, R. A. (2006). Why Creativity Is Domain General, Why It Looks Domain Specific, and Why the Distinction Does Not Matter. In *Creativity: From potential to realization.* https://doi.org/10.1037/10692-009

Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, *39*(2). https://doi.org/10.1207/s15326985ep3902_1

Plucker, J. A., & Renzulli, J. S. (2014). Psychometric Approaches to the Study of Human Creativity. In *Handbook of Creativity*. https://doi.org/10.1017/cbo9780511807916.005

Price, C. R. (2020). Do women shy away from competition? Do men compete too much?: A (failed) replication. *Economics Bulletin*. https://doi.org/10.2139/ssrn.1444100

Puryear, J. S., Kettler, T., & Rinn, A. N. (2017). Relationships of personality to differential conceptions of creativity: A systematic review. *Psychology of Aesthetics, Creativity, and the Arts*, *16*, 1–10. https://doi.org/10.1037/aca0000079

Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist, 44*(3). https://doi.org/10.1080/00461520903028990

Ren, Z., Yang, W., & Qiu, J. (2019). Neural and genetic mechanisms of creative potential. In *Current Opinion in Behavioral Sciences* (pp. 40–46). https://doi.org/10.1016/j.cobeha.2018.09.003

Rubenstein, L. D. V., Callan, G. L., & Ridgley, L. M. (2018). Anchoring the Creative Process Within a Self-Regulated Learning Framework: Inspiring Assessment Methods and Future Research. In *Educational Psychology Review* (pp. 921–945). https://doi.org/10.1007/s10648-017-9431-5

Runco, M. A. (2014). Creativity: Theories and Themes: Research, Development, and Practice. *Creativity: Theories and Themes: Research, Development, and Practice*, 1–500. https://doi.org/10.1016/C2012-0-06920-7

Runco, M. A., & Acar, S. (2012). Divergent Thinking as an Indicator of Creative Potential. In *Creativity Research Journal* (Vol. 24, Issue 1). https://doi.org/10.1080/10400419.2012.652929

Runco, M. A., & Jaeger, G. J. (2012). The Standard Definition of Creativity. *Creativity Research Journal*, *24*(1). https://doi.org/10.1080/10400419.2012.650092

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1). https://doi.org/10.1037/0003-066X.55.1.68

Said-Metwaly, S., & Kyndt, E. (2017). *Methodological Issues in Measuring Creativity: A Systematic Literature Review*. 4*. https://doi.org/10.1515/ctra-2017-0014

Sarstedt, M., Ringle, C. M., & Hair, J. F. (2021). Partial least squares structural equation modeling. Handbook of market research. In *Handbook of Market Research*.

Sawyer, R. K. (2004). Creative Teaching: Collaborative Discussion as Disciplined Improvisation. *Educational Researcher*, *33*(2). https://doi.org/10.3102/0013189X033002012

Sawyer, R. K. (2006). *Explaining creativity: The science of human innovation*. Oxford University Press.

Scott, G., Leritz, L. E., & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. In *Creativity Research Journal* (Vol. 16, Issue 4). https://doi.org/10.1080/10400410409534549

Shalley, C. E., & Gilson, L. L. (2004). What leaders need to know: A review of social and contextual factors that can foster or hinder creativity. *Leadership Quarterly*, *15*(1). https://doi.org/10.1016/j.leaqua.2003.12.004

Shalley, C. E., & Koseoglu, G. (2016). Creativity in organizations. In *The Curated Reference Collection in Neuroscience and Biobehavioral Psychology*. https://doi.org/10.1016/B978-0-12-809324-5.23703-6

Shalley, C. E., Zhou, J., & Oldham, G. R. (2004a). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management*, *30*(6). https://doi.org/10.1016/j.jm.2004.06.007

Shalley, C. E., Zhou, J., & Oldham, G. R. (2004b). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management*. https://doi.org/10.1016/j.jm.2004.06.007

Shen, X., Finn, E. S., Scheinost, D., Rosenberg, M. D., Chun, M. M., Papademetris, X., & Constable, R. T. (2017). Using connectome-based predictive modeling to predict individual behavior from brain connectivity. *Nature Protocols*, *12*(3). https://doi.org/10.1038/nprot.2016.178

Shernoff, D. J., Csikszentmihalyi, M., Schneider, B., & Shernoff, E. S. (2003). Student engagement in high school classrooms from the perspective of flow theory. In *School Psychology Quarterly* (Vol. 18, Issue 2). https://doi.org/10.1521/scpq.18.2.158.21860

Silvia, P. J. (2015). Intelligence and Creativity Are Pretty Similar After All. *Educational Psychology Review*, *27*, 599–606. https://doi.org/10.1007/s10648-015-9299-1

Silvia, P. J., Kaufman, J. C., & Pretz, J. E. (2009). Is Creativity Domain-Specific? Latent Class Models of Creative Accomplishments and Creative Self-Descriptions. *Psychology of Aesthetics, Creativity, and the Arts*, *3*(3). https://doi.org/10.1037/a0014940

Silvia, P. J., Winterstein, B. P., Willse, J. T., Barona, C. M., Cram, J. T., Hess, K. I., Martinez, J. L., & Richard, C. A. (2008). Assessing Creativity With Divergent Thinking Tasks: Exploring the Reliability and Validity of New Subjective Scoring Methods. *Psychology of Aesthetics, Creativity, and the Arts*, *2*(2). https://doi.org/10.1037/1931-3896.2.2.68

Simonton, D. K. (1999). Creativity as blind variation and selective retention: Is the creative process Darwinian? *Psychological Inquiry*, *10*(4).

Simonton, D. K. (2003). Scientific Creativity as Constrained Stochastic Behavior: The Integration of Product, Person, and Process Perspectives. In *Psychological Bulletin* (Vol. 129, Issue 4). https://doi.org/10.1037/0033-2909.129.4.475

Smallfield, J., & Kluemper, D. H. (2021). An Explanation of Personality Change in Organizational Science: Personality as an Outcome of Workplace Stress. *Journal of Management*. https://doi.org/10.1177/0149206321998429

Smith, S. M., & Blankenship, S. E. (1991). Incubation and the persistence of fixation in problem solving. *The American Journal of Psychology*, *104*(1). https://doi.org/10.2307/1422851

Smolucha, F., & Gardner, H. (1984). Art, Mind, and Brain: A Cognitive Approach to Creativity. *Journal of Aesthetic Education*, *18*(2). https://doi.org/10.2307/3332507

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sternberg, R. J. (1985). Implicit Theories of Intelligence, Creativity, and Wisdom. *Journal of Personality and Social Psychology*, *49*(3). https://doi.org/10.1037/0022-3514.49.3.607

Sternberg, R. J. (1997). Managerial intelligence: Why IQ isn't enough. *Journal of Management*. https://doi.org/10.1016/s0149-2063(97)90038-6

Sternberg, R. J. (2003). *Wisdom, Intelligence, and Creativity Synthesized*. Cambridge University Press .

Sternberg, R. J. (2006). The nature of creativity. In *Creativity Research Journal* (Vol. 18, Issue 1). https://doi.org/10.1207/s15326934crj1801_10

Sternberg, R. J., & Lubart, T. I. (2014). The Concept of Creativity: Prospects and Paradigms. In *Handbook of Creativity*. https://doi.org/10.1017/cbo9780511807916.003

Stevens, C. E., & Zabelina, D. L. (2019). Creativity comes in waves: an EEG-focused exploration of the creative brain. In *Current Opinion in Behavioral Sciences* (pp. 154–162). https://doi.org/10.1016/j.cobeha.2019.02.003

Tajfel, H., & Turner, J. (1979). An integrative theory of inter-group conflict. In *The social psychology of intergroup relations*.

Takeuchi, H., Taki, Y., Sassa, Y., Hashizume, H., Sekiguchi, A., Fukushima, A., & Kawashima, R. (2010a). Regional gray matter volume of dopaminergic system associate with creativity: evidence from voxel-based morphometry. *NeuroImage*, *51*(2), 578–585. https://doi.org/10.1016/J.NEUROIMAGE.2010.02.078

Takeuchi, H., Taki, Y., Sassa, Y., Hashizume, H., Sekiguchi, A., Fukushima, A., & Kawashima, R. (2010b). White matter structures associated with creativity: Evidence from diffusion tensor imaging. *NeuroImage*, *51*(1). https://doi.org/10.1016/j.neuroimage.2010.02.035

Tanggaard, L. (2013). The sociomateriality of creativity in everyday life. *Culture and Psychology*, *19*(1). https://doi.org/10.1177/1354067X12464987

Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management Journal*, *45*(6). https://doi.org/10.2307/3069429

Toyama, M., Nagamine, M., Asayama, A., Tang, L., Miwa, S., & Kainuma, R. (2023). Can Persistence Improve Creativity? The Effects of Implicit Beliefs About Creativity on

Creative Performance. *Psychology of Aesthetics, Creativity, and the Arts*. https://doi.org/10.1037/aca0000587

Tripathi, N., & Ghosh, V. (2020). Deep-level diversity and workgroup creativity: the role of creativity climate. *Journal of Indian Business Research*, *12*(4). https://doi.org/10.1108/JIBR-01-2019-0007

Turner, J. C. (1981). Towards a cognitive redefinition of the social group. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition*, *1*(2).

Uddin, L. Q. (2015). Salience processing and insular cortical function and dysfunction. In *Nature Reviews Neuroscience* (Vol. 16, Issue 1). https://doi.org/10.1038/nrn3857

van Knippenberg, D. (2017). Team Innovation. *Annual Review of Organizational Psychology and Organizational Behavior*. https://doi.org/10.1146/annurev-orgpsych-032516-113240

Van Knippenberg, D., De Dreu, C. K. W., & Homan, A. C. (2004). Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology*, *89*(6). https://doi.org/10.1037/0021-9010.89.6.1008

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology*, *87*(2). https://doi.org/10.1037/0022-3514.87.2.246

Vartanian, O., Martindale, C., & Kwiatkowski, J. (2007). Creative potential, attention, and speed of information processing. *Personality and Individual Differences*, *43*(6). https://doi.org/10.1016/j.paid.2007.04.027

Vartanian, O., Smith, I., Lam, T. K., King, K., Lam, Q., & Beatty, E. L. (2020). The relationship between methods of scoring the alternate uses task and the neural correlates of divergent thinking: Evidence from voxel-based morphometry. *NeuroImage*. https://doi.org/10.1016/j.neuroimage.2020.117325

Walia, C. (2019). A Dynamic Definition of Creativity. *Article in Creativity Research Journal*. https://doi.org/10.1080/10400419.2019.1641787

Wang, K., & Nickerson, J. V. (2017). A literature review on individual creativity support systems. In *Computers in Human Behavior* (pp. 139–151). https://doi.org/10.1016/j.chb.2017.04.035

Ward, T. B. (1994). Structured Imagination: The Role of Category Structure in Exemplar Generation. *Cognitive Psychology*, *27*(1). https://doi.org/10.1006/cogp.1994.1010

Weisberg, R. W. (1993). Creativity: beyond the myth of genius. In *A Series of books in psychology*.

Weisberg, R. W. R. W. (2006). Creativity: Understanding innovation in problem solving, science, invention, and the arts. *Creativity*, *50*(2).

Wilder, W. D., Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (1989). Optimal Experience: Psychological Studies of Flow in Consciousness. *Man*, *24*(4). https://doi.org/10.2307/2804304

Wu, Y., & Koutstaal, W. (2020a). Charting the contributions of cognitive flexibility to creativity: Self-guided transitions as a process-based index of creativity-related adaptivity. *PLoS ONE*, *15*(6 June). https://doi.org/10.1371/journal.pone.0234473

Wu, Y., & Koutstaal, W. (2020b). Charting the contributions of cognitive flexibility to creativity: Self-guided transitions as a process-based index of creativity-related adaptivity. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0234473

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. In *Journal of Planning Education and Research*. https://doi.org/10.1177/0739456X17723971

Yayavaram, S., Srivastava, M. K., & Sarkar, M. B. (2018). Role of search for domain knowledge and architectural knowledge in alliance partner selection. *Strategic Management Journal*. https://doi.org/10.1002/smj.2791

Young, H. R., Glerum, D. R., Wang, W., & Joseph, D. L. (2018). Who are the most engaged at work? A meta-analysis of personality and employee engagement. *Journal of Organizational Behavior*. https://doi.org/10.1002/job.2303

Yu-chu Yeh, Wei-Chin Hsu, & Elisa Marie Rega. (2019). The Dynamic Relationship of Brain Networks Across Time Windows During Product-Based Creative Thinking. *Journal of Psychology Research*. https://doi.org/10.17265/2159-5542/2019.10.002

Zabelina, D. L., & Andrews-Hanna, J. R. (2016). Dynamic network interactions supporting internally-oriented cognition. In *Current Opinion in Neurobiology* (pp. 86–93). https://doi.org/10.1016/j.conb.2016.06.014