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CREATIVITY AND INNOVATION UNDER CONSTRAINTS: A CROSS-DISCIPLINARY INTEGRATIVE REVIEW

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ABSTRACT

Generating creative ideas and turning them into innovations is key for competitive advantage. However, endeavors toward creativity and innovation are bounded by constraints such as rules and regulations, deadlines, and scarce resources. The effect of constraints on creativity and innovation has attracted substantial interest across the fields of strategic management, entrepreneurship, industrial organization, technology and operations management, organizational behavior, and marketing. Research in these fields has focused on various constraints that trigger distinct mediating mechanisms but is fragmented and yields conflicting findings. We develop a taxonomy of constraints and mediating mechanisms and provide an integrative synthesis that explains how constraints impact creativity and innovation. Our review thus facilitates cross-disciplinary learning and sets the stage for further theoretical development.

***Keywords*:** constraints, creativity, innovation, motivation, cognition, social context

CREATIVITY AND INNOVATION UNDER CONSTRAINTS: A CROSS-DISCIPLINARY INTEGRATIVE REVIEW

Creativity and innovation are the foundation of organizations' competitive advantage. To foster creativity and innovation, conventional wisdom and seminal research advocate eradicating constraints for creative minds to flourish (Amabile, 1996; Amabile & Pratt, 2016; Damanpour, 1991). However, individuals, teams, and organizations are bound by rules and regulations, limited resources, and tight deadlines. Given the ubiquity of constraints, the question arises: Do constraints always stifle creativity and innovation?

This question has attracted widespread attention from scholars in various fields, including strategic management, entrepreneurship, industrial organization, technology and operations management, organizational behavior, and marketing. However, when discussing constraints, researchers often consider different types of constraints that invoke distinct mediating mechanisms, operating at levels of analyses that range from individual and team creativity to organizational and industry-level innovation. Consequently, research is largely disconnected and has reported conflicting findings.

In the following sections, we first review extant research to derive a taxonomy of constraints – input, process, and output constraints – and reveal the underlying mechanisms and moderators. Building on these steps, we construct an integrative synthesis of when and why constraints foster or hinder creativity and innovation. Our conceptual model is based on an integration of empirical findings and suggests an inverted U-shaped effect of constraints on creativity and innovation following motivational, cognitive, and social mechanisms. It also presents a set of key moderators that shape the nature of the links between different types of constraints and mechanisms. Our review concludes with a research agenda to further stimulate cross-disciplinary learning and understanding.

This integration and conceptual development is of great importance for management research and practice. Developing an integrative framework for the role of constraints in creativity and innovation facilitates communication across disciplines and sets the stage for further theory development. It also reconciles conflicting findings by developing a theoretical basis for when and why constraints inhibit or promote motivational, cognitive, and social processes affecting creativity and innovation. From a managerial standpoint, organizations are in a constant quest for creative ideas to develop successful new products and services, improve processes, or provide the next big breakthrough. Managers therefore need to know more about how constraints affect creativity and innovation at the individual, team, and at organization levels. Constraints are simply a part of business reality and understanding how to deal with them more effectively has important implications for unleashing creativity and innovation.

SETTING THE STAGE: DELINEATING KEY CONSTRUCTS AND SCOPE

Creativity in organizations refers to the generation of novel and useful outcomes (i.e., ideas, solutions, processes, products, etc.)—a definition shared by most scholars in the creativity and innovation field (Amabile & Pratt, 2016; van Knippenberg, 2017). Novelty refers to uniqueness of an outcome compared to other outcomes that an organization already possesses, whereas usefulness refers to the extent to which an outcome is potentially valuable to an organization (Shalley, Zhou, & Oldham, 2004). We use the definition of innovation proposed by West and Farr (1990: 9) who define innovation as "the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society." This definition differentiates creativity as the generation of ideas from innovation, which encompasses their implementation. However, much research on creativity in organizations moves beyond idea generation to

include ideas put in action—in research practice, creativity and innovation often overlap considerably (van Knippenberg, 2017). Constraints are defined as any externally imposed factor (e.g., rules and regulations, deadlines, requirements, and resource scarcity) that limits creativity and/or innovation.

Given the significance of creativity and innovation for organizations to sustain competitive advantage, several excellent reviews have taken stock of the rapidly growing literature. Yet, these reviews either do not focus on the role of constraints at all (e.g., Rank, Pace, & Frese, 2004; van Knippenberg, 2017; Zhou & Hoever, 2014; Zhou & Shalley, 2003) or focus narrowly on a specific type of constraint at a single level of analysis (e.g., Amabile & Pratt, 2016; Anderson, De Dreu, & Nijstad, 2004; Anderson, Potočnik, & Zhou, 2014; George, 2007; Shalley et al., 2004). A similar pattern can also be observed in field-specific reviews. Several recent meta-analyses investigate the role of resource constraints (e.g., Evanschitzky, Eisend, Calantone, & Jiang, 2012; Weiss, Hoegl, & Gibbert, 2017) and formalization (e.g., Chen, Damanpour, & Reilly, 2010; Evanschitzky et al., 2012; Storey, Cankurtaran, Papastathopoulou, & Hultink, 2016) in new product development. Manders, de Vries and Blind (2016) reviewed ISO 9001 quality standards and product innovations, whereas the reviews by Rutherford and colleagues were confined to entrepreneurs' financial constraints (Miao, Rutherford, & Pollack, 2017; Rutherford, Pollack, Mazzei, & Sanchez-Ruiz, 2017). A recent meta-analysis on stressors and creativity includes time constraints as one type of stressor (Byron, Khazanchi, & Nazarian, 2010). Similarly, scholars discussed the role of financial resource constraints in their review of organizational search (Lavie, Stettner, & Tushman, 2010; Posen, Keil, Kim, & Meissner, 2017). We commend these efforts for advancing our knowledge on a particular type of constraint within a specific research discipline. Yet, a comprehensive understanding and cross-disciplinary integration is missing. In particular, a lack of clarity around the wide variety of constraints and their underlying

mechanisms, and the conflicting findings breed disciplinary silos. Hence, our review may facilitate cross-disciplinary dialogue to better understand how constraints affect innovation and creativity.

To provide the much-needed synthesis of prior literature, we performed an electronic database search (i.e., Scopus). Our keyword search included one creativity/innovation related word (i.e., creat*, innovat*, new product) combined with a constraint related word (i.e., constrain*, restrain*, restrict*, regulat*, autonom*, limit*, "standard*). To keep the scope of our review manageable while tapping into the state of the science, we limited our focus to studies published in journals listed in the Financial Times 50 list (i.e., a list of outlets widely regarded as representing the top of the management field) published after 2000. This selection should ensure that we base our review on the most recent publications in the most authoritative outlets. We did not limit our focus to any particular field because our goal is to develop an interdisciplinary synthesis. This search provided an initial sample of 3901 publications. We complemented this by using reference lists of relevant reviews and meta-analyses. We then analyzed the titles and abstracts of the articles to determine whether they focused on creativity and/or innovation and included some form of constraint. This step reduced our sample to 463 articles. In the last step, we examined each remaining article in detail and eliminated those without empirical evidence, a focus on effects of constraints on creativity and innovation, or organizationally relevant data. We based our review on the remaining 145 studies. Synthesizing this evidence requires a taxonomy of constraints and mediating mechanisms, which we discuss in the following section.

A TAXONOMY OF CONSTRAINTS AND MEDIATING MECHANISMS

A Taxonomy of Constraints

We developed a taxonomy of constraints based on our cross-disciplinary review in two main steps. First, we identified and clustered the constraint(s) that were studied in each

article. These clusters aimed at capturing the essence of differences among the constraints. In the second step, we iteratively compared and contrasted each constraint according to the aspects they restrain in the input-process-output model—a widely used model in prior influential work on creativity and innovation (e.g., Hülsheger, Anderson, & Salgado, 2009; West & Anderson, 1996). These efforts yielded three clusters of constraints: *input constraints, process constraints,* and *output constraints.*

The first cluster included restrictions which limit the input used for creativity. We define *input constraints* as the unavailability of resources such as time, human capital, funds, excess cash, and materials that could be used in the service of creativity and innovation activities. The second cluster included formal procedures and rules imposed on creativity and innovation processes. In other words, *process constraints* refer to the restrictions that determine the steps to be followed throughout innovation and creativity processes such as use of a formal new product development procedure or specific rules in brainstorming sessions. The final cluster concerns specifications which delineate what the output of the endeavor should be. That is, *output constraints* refer to the factors that define end result of the creative processes such as the constraints on what the output should (not) contain (e.g., use of certain materials or colors) and/or achieve (e.g., minimum product quality or performance specifications). Table 1 presents a complete list of the constraints investigated across fields and the clusters they belong to according to our taxonomy.

Insert Table 1 about here

We also compared our taxonomy to previous taxonomies. For example, Medeiros, Partlow and Mumford (2014) identified four types of constraints—fundamental, thematic, information, and resource constraints—specific to the project management context. The first

three constraints describe limitations on customer segment, marketing channels, and strategic goals. These elements map onto output constraints in our taxonomy because they demarcate search scope, whereas the fourth constraint refers to input constraints (i.e., process constraints are missing from this taxonomy). Onarheim (2012) focused on constraining search (i.e., output) and resources (i.e., input) for creative design solutions in terms of user needs, time, production and material resources, and design beliefs in the context of engineering design process (i.e., here too, process constraints are missing). Similarly, Rosso (2014) developed a taxonomy for the R&D context and classified constraints as process (i.e., time, equipment, human resources, money) and product constraints (i.e., product requirements, customer and market needs, business needs, intellectual property), which fall under input and output constraints in our taxonomy, respectively (again, process constraints as we understand them are missing, despite the label used by Rosso). Our taxonomy thus encapsulates and extends these earlier classifications. Hence, we conclude that our taxonomy is concise (i.e., does not lead to construct proliferation) and more comprehensive than existing taxonomies.

Underlying Mechanisms

Another important element in a synthesis of research and an integrative theory of constraints is to unearth the mechanisms underlying the effect of constraints on creativity and innovation. Similar to our approach for developing a taxonomy of constraints, we first listed all the mechanisms that were discussed in prior research, and then iteratively compared and contrasted these mechanisms to form clusters. This process revealed three distinct mechanisms: *motivational*, *cognitive,* and *social* routes.

The *motivational route* refers to mechanisms associated with the motivation to engage in creativity/innovation related activities. This route includes mechanisms such as (intrinsic) motivation to generate ideas, take risks, or experiment. The *cognitive route* refers to cognitive processes of creativity and innovation (e.g., cognitive fixation, opportunity identification).

Specifically, these mechanisms relate to accessing, searching for, and attending to information, and transforming and recombining that information to generate creative and innovative outcomes. The *social route* refers to the interactions between individuals, teams, and organizations in creative and innovative activities. Examples include social processes such as trust, conflict, or interaction anxiety during idea generation. Table 2 presents a detailed list of the mediating mechanisms investigated in prior research.

Insert Tables 2 and 3 about here

In the following sections, we discuss each constraint type and review available empirical evidence. We also synthesize the accumulated evidence and discuss how each type of constraint affects creativity and innovation through one or more of these mediating mechanisms. Table 3 summarizes the evidence accumulated across different fields.

INPUT CONSTRAINTS

Input constraints are the most frequently and widely studied constraint type and span across the strategic management, entrepreneurship, organizational behavior and marketing fields. Research on input constraints included firm (strategic management and entrepreneurship), team (organizational behavior and marketing), and individual (organizational behavior and marketing) levels of analyses. These fields also differ in terms of the specific type of input constraint they study. Whereas strategic management and entrepreneurship research investigates the lack or excess of financial, material, and human resources, organizational behavior focuses on the effects of time constraints. Research in marketing mainly examines a more diverse set of input constraints including time, and financial and material resources.

Most extant research highlights the negative effects of resource constraints on the motivation to engage in creativity and innovation related outcomes. Strategic management scholars, for example, mainly draw on the behavioral theory of the firm (Cyert & March, 1963) and on the resource-based view (Barney, 1991), and focus on the implications of abundant resources on managers' motivation to engage in activities that are essential for innovation (e.g., risk-taking, experimentation). The former stream suggests that slack resources (i.e., human and financial resources in excess of what is needed to sustain operations) encourage experimentation with risky projects which, in turn, yields more innovations (Bourgeois, 1981; Cyert & March, 1963; Levinthal & March, 1981). Likewise, the resource-based view stresses the importance of resources for innovation—particularly those that are valuable, rare, imperfectly imitable, and non-substitutable (Barney, 1991). In support, research findings show that slack resources increase R&D spending (Chen, 2008; Chen & Miller, 2007), produce more patent applications (Yanadori & Cui, 2013), and boost new product introductions (Natividad, 2013; Pellegrino & Savona, 2017). In a meta-analysis, Weiss et al. (2017) corroborated the importance of material resources (i.e., financial and equipment) for innovation project performance. In a similar vein, organizational behavior research often considers time resources and argues that time restrictions (i.e., deadlines or time pressures) diminish intrinsic motivation and, in turn, creativity (Amabile, 1996; Hennessey & Amabile, 2010; Shalley et al., 2004). This argument stems from self-determination theory, which posits that any external constraint reduces the perception of control and intrinsic motivation (Ryan & Deci, 2000).

Despite these generally negative portrayals of input constraints, other scholars reason that slack resources breed complacency and make managers reluctant to take risks or change strategic course. Voss, Sirdeshmukh and Voss (2008), for example, found that slack inhibits exploratory innovation. Latham and Braun (2009) also observed lower R&D expenditures in

declining software firms with slack resources before the dotcom crisis. While the studies we reviewed only provide theoretical arguments for the underlying motivational mechanisms, scholars in organizational behavior found that time pressure is positively related to individual creativity because time constraints are perceived as a challenge, which in turn motivates employees to be more creative (e.g., Andrews & Farris, 1972; Ohly & Fritz, 2010). Likewise, Sellier and Dahl (2011) provided evidence that having more materials fosters creativity by making the creative process more intrinsically enjoyable.

Researchers have also highlighted cognitive benefits of input constraints. Most of the evidence comes from entrepreneurship research across two prevalent themes. The first theme concerns financial resources that entrepreneurs lack due to an inability to raise conventional funding from investors or banks. These entrepreneurs with limited financing self-fund or rely on funds through their social networks, which is known as bootstrapping—relying on fewer financial resources than with more conventional funding (Freear, Sohl, & Wetzel Jr, 1995; Rutherford, Coombes, & Mazzei, 2012). A second theme in entrepreneurship is bricolage, which looks beyond mere financial constraints. Like bootstrapping, bricolage reflects entrepreneurship under resource scarcity. Both research streams present empirical evidence in support of how constraints can stimulate entrepreneurial growth predominantly through the cognitive route. Entrepreneurs with limited resources were found to enact idiosyncratic resource environments (Baker & Nelson, 2005), identify opportunities (An, Zhao, Cao, Zhang, & Liu, 2018), and generate novel uses of the limited resources at hand and recombine them in an innovative manner (Garud & Karnoe, 2003; Gibbert, Hoegl, & Välikangas, 2007; Harrison, Mason, & Girling, 2004; Jayawarna, Jones, & Macpherson, 2011; Jones & Jayawarna, 2010; Vanacker, Manigart, Meuleman, & Sels, 2011). Large survey studies confirm this positive effect of limited resources on firm innovativeness (e.g., An et al., 2018; Ernst, Kahle, Dubiel, Prabhu, & Subramaniam, 2015; Salunke, Weerawardena, & McColl-

Kennedy, 2013; Senyard, Baker, Steffens, & Davidsson, 2014; Wu, Liu, & Zhang, 2017) although this effect was not always consistent especially for bootstrapping (Brown, Fazzari, & Petersen, 2009; Brown, Martinsson, & Petersen, 2013, 2017; Katila & Shane, 2005; Miao et al., 2017; Rutherford et al., 2012, 2017).

Marketing research has contributed to the understanding of the relationship between input constraints and cognitive processes by documenting empirical evidence for mediators. Mehta and Zhu (2016) recently found that simply thinking about having scarce versus abundant resources (i.e., while keeping the amount of resources constant) enhances creativity by reducing cognitive fixation (i.e., tendency to fixate on a well-known solution). Scopelliti et al. (2014) showed that input constraints alter individuals' cognitive search strategies.

To reconcile these conflicting theoretical perspectives and empirical evidence, scholars have provided evidence for a curvilinear relationship. Nohria and Gulati (1996), for example, reasoned that slack resources promote experimentation at low levels while breeding complacency and loosening discipline at high levels, and documented evidence for an inverted U-shaped relationship between slack and innovation. Similar findings were documented by Kim, Kim and Lee (2008) and Mellahi and Wilkinson (2010). Likewise, Bendoly and Chao (2016) showed that time constraints in new product development has an inverted U-shaped relationship with the market performance of those products. In organizational behavior, scholars argued that employees are stimulated optimally at moderate levels of constraints, and showed empirical evidence for an inverted U-shaped relationship between time constraints and creativity (e.g., Baer & Oldham, 2006; Ohly, Sonnentag, & Pluntke, 2006). In addition to identifying curvilinear effects, scholars cast further light on these inconsistent perspectives and findings by identifying a number of moderators, which are presented in Table 3 (as well as the moderators for other types of constraints).

In sum, input constraints on creativity and innovation have received wide-spread attention across these fields. Irrespective of the level of analysis, these fields provide theoretical reasoning and empirical evidence for positive, negative, and curvilinear effects. They also emphasize either motivational or cognitive mechanisms for the effect of input constraints on creativity and innovation, although empirical evidence for mediators is scarce.

PROCESS CONSTRAINTS

Process constraints has attracted interest from strategic management, technology and operations management, and organizational behavior. The main interest focuses on how formalization, "the degree to which a codified body of rules, procedures or behavior prescriptions is developed to handle decisions and work processing" (Pierce & Delbecq, 1977, p. 31), affects innovative outcomes at firm, project, and team levels. Organizational behavior scholars investigated the effects of specific rules and routines (e.g., brainstorming rules) for team creativity while also examining the role of job autonomy—i.e., the freedom to determine how to carry job tasks (Hackman & Oldham, 1976, 1980)—at the individual level.

Most extant research suggests that process constraints are detrimental for motivational mechanisms in creativity and innovation. Organizational behavior scholars have long highlighted the importance of job autonomy and have provided theoretical arguments and empirical evidence for positive effects of providing employees with discretion over work decisions, schedules, and methods. Specifically, researchers found that autonomy enhances employees' intrinsic motivation, prosocial motivation and creative self-efficacy, and in turn their creativity (Liu, Jiang, Shalley, Keem, & Zhou, 2016; Oldham & Cummings, 1996; Parker, 2014; Shalley et al., 2004). For example, Andrews and Farris (1967) found that scientists were more creative when they attained greater autonomy. Similarly, employees who experience higher level of autonomy were found to contribute more to their organization's idea management system (Hatcher, Ross, & Collins, 1989). In a similar vein,

formalization is often argued to limit openness and reduce employees' motivation to engage in creative behavior (Adler & Borys, 1996; Pierce & Delbecq, 1977), although empirical evidence has not always been consistent (Damanpour, 1991).

In contrast, scholars in technology and operations management as well as in organizational behavior advocate that process constraints may contribute to social processes of innovation. Process constraints that provide guidelines for interaction with peers and structure for collaboration increase knowledge sharing and trust (Adler & Borys, 1996; Brattström, Löfsten, & Richtnér, 2012; De Clercq, Dimov, & Thongpapanl, 2013; Tushman & Anderson, 2004). In particular, technology and operations management field document strong positive evidence for the value of relying on explicit rules and standard procedures in new product and service development processes. These constraints are argued to facilitate communication and coordination across tasks and functions and to reduce uncertainty and conflict (Moenaert & Souder, 1990). Indeed, a number of meta-analytical studies provide positive evidence for the formalization-innovation relationship (Chen et al., 2010; Evanschitzky et al., 2012; Storey et al., 2016). Scholars have also explored the role of specific innovation frameworks, which constrain the innovation process by delineating the must-do procedures and routines in new product development (NPD) (Sethi & Iqbal, 2008; Wilson & Doz, 2011). For example, the stage-gate model, a widely adopted innovation framework, breaks up the traditional new product development process into a series of stages where work for a specific element of innovation is undertaken and gates (i.e., control points) where go/kill decisions are made about the project (Cooper, 1990, 2008). The structure provided by this framework is argued to facilitate social processes of innovation such as team communication and knowledge sharing, and in turn to enhance NPD performance and efficiency (Cooper, 2008; Cooper & Sommer, 2016).

Organizational behavior researchers also embrace a similarly positive view of process constraints. The brainstorming literature focuses on the role of brainstorming rules—i.e., withholding criticism, generating a large number of ideas, building on ideas, and welcoming wild ideas (Osborn, 1957)—in team creativity. Such rules stimulate social processes of creativity by helping overcome social barriers associated with intra-team exchanges. During brainstorming, team members may hesitate to share their ideas due to the fear of negative evaluations (i.e., evaluation apprehension), have to wait for their turn to speak (i.e., production blocking), or reduce effort (i.e., social loafing) (Camacho & Paulus, 1995; Diehl & Stroebe, 1987; Mullen, Johnson, & Salas, 1991). Studies found that teams using clear rules that constrain intra-team exchanges to mitigate these problems tend to generate more ideas than those who do not (Girotra, Terwiesch, & Ulrich, 2010; Meadow, Parnes, & Reese, 1959; Nemeth, Personnaz, Personnaz, & Goncalo, 2004; Parnes & Meadow, 1959; Stam, de Vet, Barkema, & De Dreu, 2013). For example, Sutton and Hargadon (1996) observed that clear and visible rules enabled employees to generate creative solutions to various design problems, and Goncalo et al. (2015) showed that imposing political correctness norms reduces uncertainty regarding social interactions, which in turn fosters creative ideas.

Researchers also suggest that relying excessively on process constraints might backfire. Strict controls in stage-gate processes hamper project flexibility and learning, and in turn the market performance of new products (Sethi & Iqbal, 2008). More flexible approaches that include clear procedures on seeking early market and technological feedback (e.g., concurring engineering, lean startup model) improve innovation performance (Blank, 2013; MacCormack, Verganti, & Iansiti, 2001; Ries, 2011). These results suggest that the relationship between process constraints and creative outcomes may take the form of an inverted U. Indeed, Andrews and Smith (1996) found that planning process formalization has a curvilinear relationship with creativity of marketing programs.

In sum, process constraints have received attention across different research fields with a focus ranging from organizational rules, procedures, and frameworks to individual and team creativity and innovation. On the one hand, even counter-intuitive process constraints such as imposing political correctness help creativity and innovation by regulating social interactions and building trust. On the other hand, excessive process constraints can hamper motivational processes. Researchers have also documented empirical evidence for a curvilinear relationship between process constraints and creativity while also documenting a number of moderators.

OUTPUT CONSTRAINTS

Extant research on output constraints has mainly focused on the role of regulations and standards in industrial organization and technology and operations management fields. Regulations constrain the search space for innovation activities by, for example, banning, taxing, or incentivizing the use of particular materials, processes, or standards. Examples include the European Emissions Trading Scheme's cap on CO2, SO2, and NOx emissions (Horbach, Rammer, & Rennings, 2012), and privacy regulations that delineate the design specifications of information systems (Borghesi, Cainelli, & Mazzanti, 2015). Similarly, standards specify what products, services, technologies, or systems must conform to such as those on performance and safety requirements, on interface and compatibility in information and communication technologies (e.g., the 3G telecommunication standardization), and on product/technology variety reduction (e.g., standards that curb variance in nanotechnology) (Allen & Sriram, 2000; Blind & Gauch, 2009; Zoo, de Vries, & Lee, 2017). Other output constraints, which received interest from marketing and organizational behavior scholars, include specifications that a product/design should meet (Moreau & Dahl, 2005; Rosso, 2014). While research on regulations and standards focus on firm, industry and country level

output constraints and innovativeness, expected product specifications often focus on individual and project level creative performance.

Early research generally had a negative view of output constraints. For example, researchers argued that regulations hampered innovations because firms incurred costs to comply with regulations and penalties—funds that would otherwise have been available for R&D (see review of Ambec, Cohen, Elgie, & Lanoie, 2013). Similarly, standards were traditionally considered to be antithetical to creativity and innovation. This was because standards promote consistency, uniformity, and reduction in variety whereas creativity and innovation necessitate differentiation, novelty, and variation (Gilson, Mathieu, Shalley, & Ruddy, 2005).

These views have now evolved to a more positive depiction of output constraints. Most scholars argue that regulations drive organizations to adapt and innovate in ways to ensure compliance (Berrone, Fosfuri, Gelabert, & Gomez-Mejia, 2013; Lee, Veloso, & Hounshell, 2011; Popp, 2003, 2006). Indeed, recent research corroborated the positive effects of regulations on patent filings as a result of the European Emissions Trading Scheme (Calel & Dechezleprêtre, 2016), of emission regulations in the US auto industry (Lee et al., 2011), and of biofuel regulations (Costantini, Crespi, Martini, & Pennacchio, 2015). Likewise, studies drawing on the Community Innovation Surveys show a positive regulatory impact on innovation both in Germany (Horbach, 2008; Horbach et al., 2012) and in Italy (Borghesi et al., 2015). Huesig, Timar, and Doblinger (2014) noted that stringent regulations spur mobile network operators to enter new markets. Cecere and Martinelli (2017) documented an increase in academic publications as a result of regulations related to electrical and electronic equipment waste. Standards were also argued to promote innovation by channeling attention towards new knowledge and by providing stable interfaces to build on (de Vries & Verhagen, 2016; Xie, Hall, McCarthy, Skitmore, & Shen, 2016; Yoo, Lyytinen, & Yang, 2005). Beyond

standards and regulations, researchers found that product/design requirements can stimulate creativity and innovation (Moreau & Dahl, 2005; Rosso, 2014).

Empirical evidence testing the mechanisms through which output constraints affect creativity and innovation is scarce. Yet, the limited evidence highlights the cognitive route. Specifically, technology and operations research shows that standards codify accumulated knowledge on which innovations can be built (Allen & Sriram, 2000). Marketing scholars documented that output constraints in the design process reduce the tendency to suggest only the most obvious solutions (Moreau & Dahl, 2005). Organizational behavior scholars found that output constraints affect creativity by delineating search boundaries (Rosso, 2014). While these findings suggest a positive effect of output constraints on creativity and innovation, qualitative case studies of an engineering design process (Onarheim, 2012) and R&D teams (Rosso, 2014) reported a curvilinear effect for output constraints.

In summary, prior research has focused on various output constraints at different levels of analysis ranging from environmental regulations at industry level to product design specifications at individual level. Scholars predominantly provide theoretical reasoning and empirical evidence for a positive relationship between output constraints and creative outcomes, although early research reported negative effects. Some qualitative evidence indicates an inverted U-shape relationship. Researchers have also developed theory and documented evidence in relation to cognitive processes. Although some scholars argue for the motivational effects of output constraints, they often do not offer empirical evidence to support these predictions.

AN INTEGRATIVE SYNTHESIS

Building on our review and the proposed taxonomy for both constraints and mediating mechanisms, we develop a theoretical framework that explains how different types of constraints affect creativity and innovation. Our framework offers four important insights.

First, we propose that there is theory and evidence for an inverted U-shaped relationship between constraints, and creativity and innovation. The curvilinear effects theorized below can explain empirical evidence for positive, negative, or non-significant effects as these studies may have tapped into different parts of the whole range of constraints, which might have led scholars to sometimes examine the positive, sometimes the negative, and sometimes the flat part of the curve. Second, similar to the assertion of Amabile and Pratt (2016), we argue that this effect is similar regardless of whether the focus is on individual, team, or organizational creativity and innovation. Third, these curvilinear effects operate through different pathways depending on the type of constraint. Fourth, in parallel and not necessarily isolated from the curvilinear effects, these pathways are contingent on several moderators, which can also cast light on inconsistent findings. However, the evidence for the curvilinear effects suggest that the disparate effects cannot be explained only by moderation. Figure 1 depicts these insights based on available empirical evidence and identifies potential research gaps. We next detail these relationships for each type of constraint.

Insert Figure 1 about here

The Effect of Constraints on Creativity and Innovation

Input constraints affect creativity through motivational and cognitive routes. Regarding the motivational route, having too few input constraints breeds complacency (Kim et al., 2008; Nohria & Gulati, 1996). A moderate level of input constraints, however, frames the task as a greater challenge, and in turn motivates experimentation and risk-taking (Baer & Oldham, 2006; Ohly & Fritz, 2010). This moderate level also prompts a mindset to maximize the creative value generated from available resources, to search for novel combinations using what is at hand, and to think beyond traditional solutions (Baker & Nelson, 2005; Mehta &

Zhu, 2016; Scopelliti et al., 2014). However, input constraints become detrimental to motivational processes in creativity and innovation after a threshold. Creativity and innovation-related activities need time, talent, funds, and equipment. Imposing excessive constraints discourages risk-taking and experimentation (Bourgeois, 1981; Cyert & March, 1963; Levinthal & March, 1981) and can harm feelings of self-determination (Ryan & Deci, 2000). Without feeling in control, individuals and teams are not motivated to engage in creative activities (Amabile, 1996; Shalley et al., 2004).

Process constraints affect creativity and innovation through social and motivational routes. These constraints facilitate social interactions by coordinating collective efforts in innovation processes and by mitigating social barriers that hinder knowledge exchanges (Camacho & Paulus, 1995; De Clercq et al., 2013; Goncalo et al., 2015). Not having constraints on social interactions inhibits devoting sufficient attention to derive creative value from these interactions because individuals, teams, and organizations have limited attentional span (Hirst, van Knippenberg, Zhou, Quintane, & Zhu, 2015; Perry-Smith & Shalley, 2003). However, creativity and innovation can be hampered when process constraints are too strict (MacCormack et al., 2001; Sethi & Iqbal, 2008). Excessive rules guiding social exchanges inhibit spontaneous and random encounters and idea sharing that are often needed to spark creative insights (Schilling, 2005). Moreover, constraining interactions through formal mechanisms diminishes intrinsic motivation, creative self-efficacy, and prosocial motivation (Liu et al., 2016; Oldham & Cummings, 1996; Shalley et al., 2004).

Output constraints influence motivational and cognitive processes. These constraints set the boundaries of the solution space, affecting how a creative solution is searched (Rosso, 2014). When there are no constraints on the search space, decision makers are prone to select the most intuitive solution rather than trying to identify novel ones—a process referred to as following the “path-of-least-resistance” (Ward, 1994, 2004). This is because retrieving a

known solution is cognitively less demanding than exploring innovative ones. Naturally, this process leads to conventional ideas that are based on previous experience (Stokes, 2001). Introducing output constraints may alter the conditions under which solutions are generated and, in turn, spark unconventional thinking and exploration of novel ideas (Finke, Ward, & Smith, 1992; Moreau & Dahl, 2005). In addition, moderate levels of output constraints are perceived as a creative challenge, and motivate efforts toward finding novel ways to meet desired output criteria (Berrone et al., 2013; Rosso, 2014). However, output constraints that are too strict overly limit the conceptual elements that could potentially be recombined to create a novel outcome. Drawing on fewer elements implies a smaller number of possible connections among them, which reduces the chances of developing atypical associations (Acar & van den Ende, 2016; Schilling & Green, 2011). This is critical because prior research considers cognitive search processes that lead to novel associations between existing ideas, concepts, and knowledge to be the primary source of creativity and innovation (Fleming, 2001; Hennessey & Amabile, 2010; Mednick, 1962).

Moderators

Our review also identifies a set of moderators. Specifically, it reveals that radicalness of innovation projects moderates all three pathways whereas a number of individual, team, and firm characteristics, as well as contextual factors influence specific pathways. The motivational route through which input and process constraints operate is moderated by characteristics that shape how a constraint is viewed. A constraint can be perceived as a source of creative challenge or a control attempt, based on which motivational reactions vary (Adler & Borys, 1996; Miron-Spektor, Ingram, Keller, Smith, & Lewis, 2018; Rosso, 2014). Moderators that portray constraints as a creative challenge motivate exploration of novel solutions. In contrast, characteristics that result in seeing constraints as a control attempt discourage creative endeavours. The inverted U-shaped relationship between constraints, and

creativity and innovation shifts leftward or rightward as the moderators shape whether these constraints are perceived as challenging or controlling. To illustrate, when constraints are perceived to be controlling, they become detrimental earlier, and vice versa. We encourage future research to empirically test how these moderators shift the curve and to explore further moderators by focusing on factors that may influence the interpretation of constraints.

Regarding the cognitive route, the characteristics that influence the capability to navigate search space for creative solutions determine the effects of input and output constraints. Employees, managers, teams, or organizations differ based on their prior experience, expertise, and absorptive capacity, which may in turn influence whether and how they benefit from (un)restrained search space, and the extent to which they tend to fixate on uncreative solutions (Acar & van den Ende, 2016; Cohen & Levinthal, 1990; Fabrizio, 2009; Salge, Farchi, Barrett, & Dopson, 2013; Sellier & Dahl, 2011). Regarding contextual factors, supportive mechanisms and climate impact capability to innovate under constraints by facilitating the task of searching broadly across different domains and making connections between them (Acar & van den Ende, 2016; Li, Maggitti, Smith, Tesluk, & Katila, 2013). Overall, our review suggests that constraints are more effective in sparking creativity and innovation under limited search capability. We are unaware of any direct empirical study on this linkage, and encourage researchers to address this and explore novel moderators.

The social route, through which process constraints operate, can be influenced by the moderators related to the need and value of social interactions. Factors that reduce the potential added value of social interactions move the inverted U-shaped curve leftward. For example, researchers theorized that the type and value of social relationships vary between idea generation, idea elaboration, idea championing, and idea implementation stages of innovation (Perry-Smith & Mannucci, 2017). Procedures that promote interactions with a large number of parties that are naturally distant from each other may be beneficial for

generating ideas but may hamper elaboration processes. We encourage future research to explore alternative moderators that can determine the value generated by social interactions.

Radicalness of innovation projects and creativity tasks is a key moderator that affects motivational, cognitive, and social routes. Compared to incremental innovation projects, radical projects often require greater flexibility and freedom in terms of resources, rules, procedures, or requirements (Benner & Tushman, 2003; Christensen, 2013). Empirical evidence has been found for the negative interactive effects of input, process, and outcome constraints, and for project type on creative outcomes (Benner & Tushman, 2002; Klingebiel & Adner, 2015; Madjar, Greenberg, & Chen, 2011). Drawing on this evidence, the inverted U-shaped relationship shifts leftward for radical innovation projects.

MOVING CONSTRAINTS THEORY FORWARD

The diverse yet isolated set of fields we reviewed essentially try to answer the very same question: How do constraints impact creativity and innovation? Our integrative framework synthesizes the available empirical evidence across the fields. Equally important, this framework also reveals several important gaps and new research avenues for these disciplines to learn from each other, which we discuss next.

Investigating Combinative Effects of Constraints

We observe that most fields predominantly focus on a single type of constraint. Due to this limited focus, knowledge about relevant constraints identified in other fields has not been transferred to other fields and the interactive effects of different constraints have been overlooked. First, scholars could identify underexplored constraints within their own fields and learn from the research in others where those constraints received substantial empirical evidence. Strategic management research, for instance, investigates mainly input constraints while industrial organization research focuses on output constraints. Drawing on our taxonomy of constraints, future research in strategic management can explore how

regulations shape innovative performance in firms with slack resources, and vice versa. Such an advance can contribute to both fields by shedding light on how policy makers can mitigate firms' complacency and direct their slack resources toward innovation activities through effective regulations.

Second, research has not addressed whether different constraints interact in their effect on creativity and innovation. For constraints within the same category, the interplay between constraint types might be relatively straightforward as they invoke the same mechanisms and influence creative outcomes in the same way. To illustrate, our integrative framework suggests that both deadlines and financial slack, which concern input constraints, have an inverted U-shaped relationship with creativity and innovation through motivational and cognitive routes. These constraints could therefore be complements. For example, the impact of a strict deadline on creative outcomes would be expected to depend on financial constraints and on how far those constraints are from the optimal level for input constraints. This effect could be negative (when financial constraints are at the optimal level or surpass it), positive (when financial constraints fall substantially short of the optimal level and adding time constraints do not surpass that level) or even curvilinear (when financial constraints fall slightly short of the optimal level and adding time constraints surpasses that level). Empirical research testing the interplay between financial and time constraints (as well as other constraints that belong to same category) is needed.

The interactive effects are more complex when considering simultaneous effects of constraints from different categories, as these constraints may invoke different mechanisms. On the one hand, such constraints can substitute each other. For example, Moreau and Dahl (2005) found that output constraints foster creativity only when there is sufficient time to search. On the other hand, there might be cases when different types of constraints complement each other. For instance, output constraints, such as regulations, can be more

effective for firms with limited financial resources. Drawing on our integrative framework, we expect that the interactive effects of constraints depend on the processes they stimulate. The interplay between constraint types that invoke the same mechanisms may be similar to the interplay between constraints that belong to the same category. That is, input and output constraints, as they both stimulate cognitive processes, may interact similarly to how different input constraints, or different output constraints, interact. However, process constraints, providing they are not extreme, may complement the effects of input or output constraints by stimulating social processes of creativity and innovation. Because (i) the effect of a constraint is likely to be determined collectively by other constraints (within the same or a different category) and (ii) all types of constraints are expected to have a non-linear relationship with creative outcomes, we strongly encourage future research to consider multiple constraints to advance the constraints theory of creativity and innovation.

Exploring Missing Mechanisms

Our integrative model shows that there is a lack of empirical evidence on how input and output constraints affect social mechanisms, how output constraints affect motivational mechanisms, and how process constraints affect cognitive mechanisms for creative solutions. This lack of empirical research does not mean that those relationships do not exist. In other words, whether one type of constraint affects all three mediators or whether it influences multiple mechanisms simultaneously remains unanswered. We call for future research to include multiple mechanisms in a single study (for a recent discussion, see Aguinis, Edwards, & Bradley, 2017) as this could allow us to explore whether and how these mechanisms interrelate and identify their relative place in a causal chain. In addition, by addressing multiple mediating mechanisms simultaneously, we can observe whether a constraint has opposing effects on different mediating processes. For example, time constraints may be detrimental for the social processes of creativity and innovation (as collaboration and cross

disciplinary interaction require time), while at the same time promoting cognitive processes of creativity.

There is also great potential for cross-disciplinary connections for a better understanding of why a particular type of constraint impacts creativity and innovation. In particular, extant research has either not empirically tested mediating mechanisms, has focused on one particular mechanism, or has overlooked the mechanisms identified in other fields. For example, some fields, such as technology and operations management, have traditionally not tested mediating mechanisms, whereas other fields such as organizational behavior have. Hence, research on innovation frameworks have often overlooked mediating processes and can build on insights from organizational behavior research on social interactions and creativity to identify when and why process constraints boost NPD performance. Even within the disciplines where mediators are traditionally emphasized, scholars sometimes focus on different mechanisms for the same type of constraint. To illustrate, marketing research features cognitive processes as the main mechanism between input constraints and creativity, whereas organizational behavior research often focuses on motivational processes for this link. Our framework integrates these insights and suggests multiple routes for each constraint type; however empirical research testing these mechanisms simultaneously is missing. Overall, we encourage future research to explore these missing mechanisms and model multiple mechanisms. This avenue offers a fertile ground for mutual learning as the emphasis given to mediating mechanisms differs among research fields.

Developing a More Fine-Grained Understanding of Constraints

Our review indicates that constraints not only differ in terms of their type and level, but also in terms of their enforcement, malleability, and timing, all of which can potentially influence their effect on creativity and innovation. The first characteristic, *enforcement,* refers

to the incentives used to ensure compliance with them. For example, enforcement of regulations is often done by banning or taxing the use of certain materials. The enforcement element itself is likely to have motivational consequences above and beyond the regulation itself. In addition, whether constraints encourage a certain behavior (i.e., carrot approach) or discourage it (i.e., stick approach) may vary in terms of their effectiveness (e.g., Andreoni, Harbaugh, & Vesterlund, 2003; Chen, Ramamurthy, & Wen, 2012). Future studies can compare these approaches to investigate whether they stimulate greater compliance or backfire.

Malleability refers to the extent to which a constraint is flexible (i.e., whether it could be removed or amended). For example, Onarheim (2012) observed that engineers described constraints as changeable (vs. frozen) or negotiable (vs. non-negotiable). Malleability of a constraint might impact intrinsic motivation and creative cognition. Future studies can explore how this aspect relates to freedom in the process of creation, and in turn to perceptions of self-determination and a broader cognitive search process.

Timing of constraints refers to when exactly in the innovation process a constraint is introduced. To illustrate, a constraint could be imposed at the beginning of the innovation process or after the idea generation phase of innovation, which may have implications for the final outcome of the innovation process. Future research could explore the effects of timing by testing the effects of introducing a constraint after removing another to avoid over-constraining the innovative process.

Overall, enforcement, malleability and timing of constraints are likely to moderate the curvilinear link between different types of constraints, and creativity and innovation. We therefore strongly encourage future research to include these elements in their theoretical and empirical models to develop a fine-grained theory of constraints. Scholars may, for example,

experimentally manipulate or measure these elements, and test the extent to which they affect the motivational, cognitive and social processes of creativity and innovation.

PRACTICAL IMPLICATIONS

Our integrative framework of constraints has important implications for policy makers, managers, and entrepreneurs. One common insight from studies across different fields and from our framework is that the key to creativity and innovation is not to remove all constraints. Contrary to conventional wisdom (Amabile, 1996; Damanpour, 1991), it is certainly possible to innovate better, for example, by intentionally restricting time, funds or other assets. These insights are embodied in recently popularized management practices such as agile management and lean startup principles, whose inner functioning has remained a black box. Our framework clarifies why certain practices such as developing a minimum viable product with limited money and time (i.e., input constraints), soliciting early customer feedback (i.e., output constraints), and having daily stand-up meetings (e.g., process constraints) increase creative performance. It could also explain why iPhone 4's success is attributed to material constraints imposed on its design (Onarheim, 2012) or why some practitioners argue that 'creativity loves constraints' (Mayer, 2006). Yet, our framework also suggests that constraining the creative process too much backfires after a threshold. As such, the formula to unlocking the creative and innovation potential of employees, teams and firms is applying the *right* amount of constraints.

Identifying the optimal level of constraints for creativity and innovation requires taking different constraint types into account simultaneously. We therefore advise firms to reach beyond mere resource allocations, and design input, process, and output constraints in tandem. For example, by applying research on bootstrapping and bricolage, established firms may cap resources to corporate entrepreneurship initiatives to motivate employee ideation toward more effective uses of the available resources. At the same time, firms can set rules

governing team dynamics and innovation processes, and clarify output constraints demarcating the search. In doing so, managers should carefully assess the organizational, project, and employee characteristics as well as other contextual factors. For example, radical innovation projects benefit from relaxing constraints. In contrast, several factors such as overall support for creativity and innovation within an organization may lead employees to view constraints in a more positive light, which in turn motivates them to be more creative under stricter constraints. As a whole, a valuable approach for managers is conducting small business experiments and using validated learnings from these experiments to identify the *right* combination of a tailored constraint structure that works best for their company.

CONCLUSION

Constraints are part and parcel of organizational processes and people's daily lives. The role of constraints in creativity and innovation has been investigated in various fields, but with conflicting results. Our review not only synthesizes and organizes this research by providing a taxonomy of the various types of constraints and mediating mechanisms, but also offers a much-needed integration between fragmented research in these disciplines by developing an integrative framework. In particular, our framework suggests an inverted U-shaped relationship between constraints, and creativity and innovation while also tying specific constraints with distinct underlying mechanisms. That is, this review informs which mediating process(es) will be in place once the type of constraint is known, and in turn helps predicting how constraints relate to creative outcomes at different units of analysis. In addition, our framework offers a theoretical basis for identifying conditions under which a certain mechanism is invoked, pronounced, or attenuated. As a whole, our integrative review takes an important step toward explaining how, why, and when constraint types affect multi-level outcomes relating to creativity and innovation, facilitates communication between scholars from different fields, and consequently sets the stage for further theory development.

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Table 1

Constraints Discussed in Extant Literature

Specific Constraints	**Type**	**Illustrative References**
Financial resource constraints (e.g., project budget, financial slack)	Input	(Kim et al., 2008; Scopelliti et al., 2014)
Human resource constraints (e.g., downsizing, human resource slack)	Input	(Mellahi & Wilkinson, 2010; Nohria & Gulati, 1996)
Equipment constraints	Input	(Weiss et al., 2017)
Time constraints (e.g., deadlines, workload, time pressure)	Input	(Baer & Oldham, 2006; Ohly & Fritz, 2010)
Supply constraints	Input	(Hanlon, 2015; Sellier & Dahl, 2011)
Formalization (e.g., formalized NPD process)	Process	(Damanpour, 1991; Evanschitzky et al., 2012)
(Lack of) job/task autonomy	Process	(Liu et al., 2016; Oldham & Cummings, 1996)
Creativity rules (e.g., brainstorming rules)	Process	(Camacho & Paulus, 1995; Sutton & Hargadon, 1996)
Regulations (e.g., environmental/ privacy regulation)	Output	(Berrone et al., 2013; Kesidou & Demirel, 2012)
Standards (e.g., minimum quality standards, compatibility standards)	Output	(Allen & Sriram, 2000; Blind, Petersen, & Riillo, 2017)
Project outcome requirements (e.g., design specifications, product requirements)	Output	(Moreau & Dahl, 2005; Rosso, 2014)

Table 2

Mediators Discussed in Extant Literature

Mediators	**Mechanism Type**	**Illustrative References**
Experimentation and risk taking	Motivational	(Damanpour, 1991; Nohria & Gulati, 1996)
Intrinsic motivation*	Motivational	(Liu et al., 2016)
Creative self-efficacy*	Motivational	(Liu et al., 2016)
Challenge appraisal*	Motivational	(Ohly & Fritz, 2010)
Prosocial motivation*	Motivational	(Liu et al., 2016)
Activation	Motivational	(Baer & Oldham, 2006)
Compliance	Motivational	(Berrone et al., 2013)
Search boundaries*	Cognitive	(Rosso, 2014)
Opportunity identification*	Cognitive	(An et al., 2018)
Cognitive fixation*	Cognitive	(Mehta & Zhu, 2016)
Deviation from path-of-least-resistance*	Cognitive	(Moreau & Dahl, 2005)
Cognitive search strategy*	Cognitive	(Scopelliti et al., 2014)
Trust*	Social	(Brattström et al., 2012)
Interaction uncertainty*	Social	(Goncalo et al., 2015)
Interaction anxiousness*	Social	(Camacho & Paulus, 1995)
Production blocking*	Social	(Diehl & Stroebe, 1987)
Internal knowledge sharing	Social	(De Clercq et al., 2013)
Interpersonal conflict	Social	(Nemeth et al., 2004)

*Denotes presence of empirical evidence for mediation

Table 3

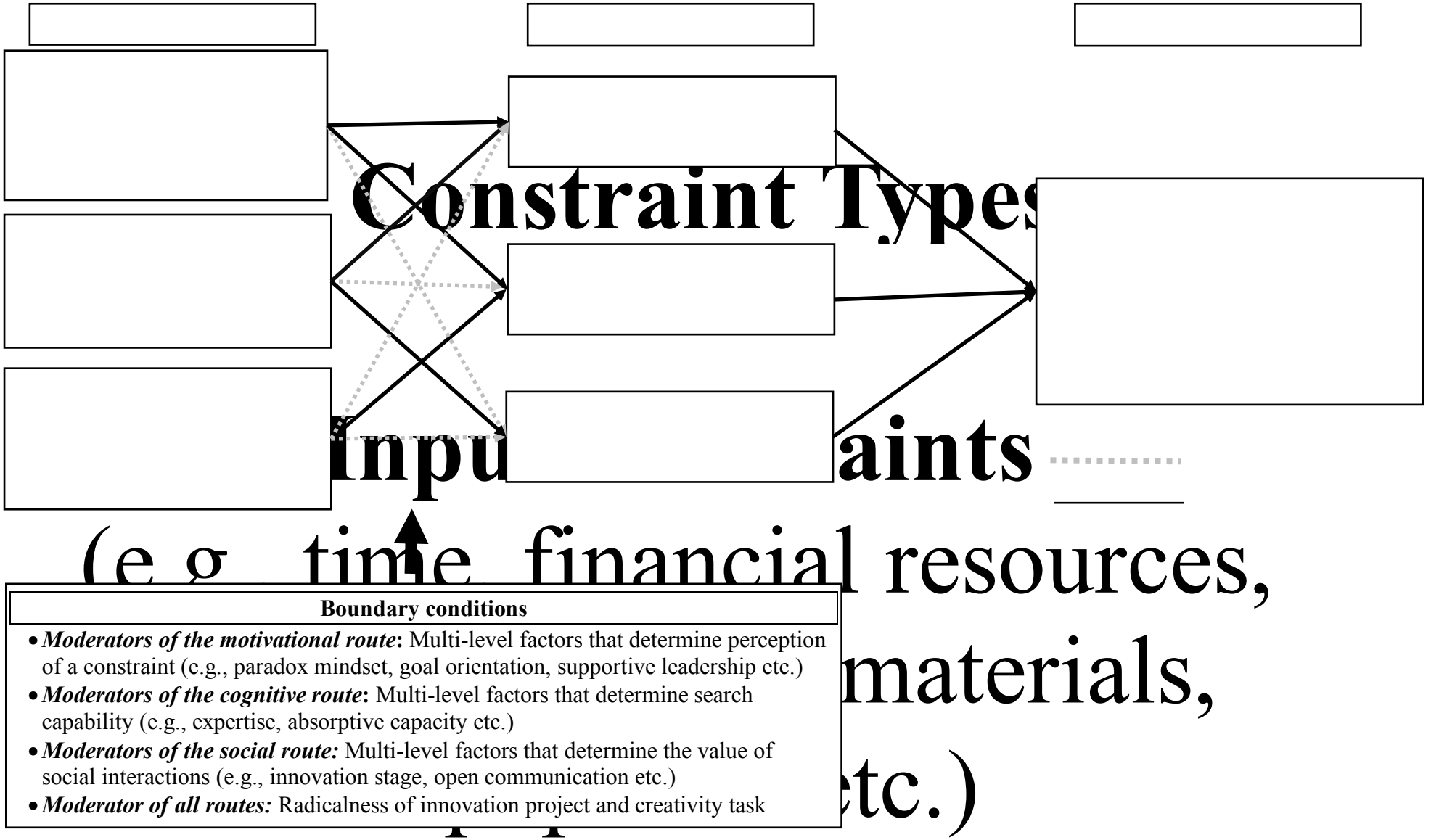
Overview of the Research on Constraints, Creativity and Innovation

Unit	Effect	Mediating Mechanisms	Moderators
Input constraints			
Firm/ Industry	Positive, negative, nonsignificant and inverted U-shaped	***Motivational:*** Motivation to take risks and engage experimentation ***Cognitive:*** Opportunity identification* (An et al., 2018); Recombination of limited resources in novel ways* (Baker & Nelson, 2005)	Firms' ownership structure (Kim et al., 2008; Latham & Braun, 2009), pay dispersion (Yanadori & Cui, 2013), prior performance (Berrone et al., 2013), technology span (Bendoly & Chao, 2016); Markets' technological turbulence (Wu et al., 2017), environmental change (van Rijnsoever, Meeus, & Donders, 2012); Managers' resourceful mindset (Halme, Lindeman, & Linna, 2012), learning orientation (An et al., 2018), diversity of experience and intrinsic motivation (Andrews & Smith, 1996);
Project / Team	Positive, negative and nonsignificant	***Motivational:*** Intrinsic motivation* (Rosso, 2014)	Organizational dynamics (e.g. open communication, collaboration, managerial support, trust etc.) (Rosso, 2014), team climate for innovation (Weiss, Hoegl, & Gibbert, 2011), power distance (Weiss et al., 2017)

Individual	Positive, negative, nonsignificant and inverted U-shaped	***Motivational:*** Intrinsic motivation; Challenge appraisal* (Ohly & Fritz, 2010); Task enjoyment * (Sellier & Dahl, 2011); Activation (Baer & Oldham, 2006) ***Cognitive:*** Cognitive fixation* (Mehta & Zhu, 2016); cognitive search strategies* (Scopelliti et al., 2014)	Employees' openness to experience personality trait (Baer & Oldham, 2006), paradox mindset (Miron-Spektor et al., 2018), need for cognition (Wu, Parker, & De Jong, 2014), regulatory focus (Sacramento et al., 2013), novelty-seeking tendency (Scopelliti et al., 2014), experience (Sellier and Dahl, 2011)
Process constraints			
Firm/ Industry	Positive, negative, nonsignificant and inverted U-shaped	***Motivational:*** Encouraging new ideas and behavior (Damanpour, 1991) ***Social:*** Trust* (Brattström et al., 2012)*;* knowledge sharing (De Clercq et al., 2013)	Industry type (photography vs. paint); firm type (for-profit vs. not for profit) (Damanpour, 1991)
Project/ Team	Positive, negative and non-significant	***Social:*** Conflict (Nemeth et al., 2004)*;* Interaction anxiousness* (Camacho et al., 1995)*;* Interaction uncertainty* (Goncalo et al., 2015)*;* Production blocking* (Diehl & Stroebe, 1987)	Team members' goal orientation (Hirst, van Knippenberg, Chen, & Sacramento, 2011), dispositional anxiousness (Camacho & Paulus, 1995), extraversion (Stam et al., 2013), training (Parnes & Meadow, 1959); Team size (Mullen et al., 1991); Brainstorming dynamics (response mode, nominal group type) (Mullen et al., 1991)

Individual	Positive and negative	***Motivational:*** Intrinsic motivation*; Creative self-efficacy**;** Prosocial motivation* (Liu et al., 2016)	Employees' need for cognition (Wu et al., 2014); level of supportive supervision (Oldham & Cummings, 1996)
Output constraints			
Firm/ Industry	Positive and negative	***Motivational:*** Compliance (Berrone et al., 2013) ***Cognitive:*** Knowledge codification* (Allen & Sriram, 2000)**;** Search for new knowledge (Xie et al., 2016)	Firms' innovativeness (Kesidou & Demirel, 2012), size (Chakraborty & Chatterjee, 2017), origin (domestic vs. foreign) (Chakraborty & Chatterjee, 2017; Lee et al., 2011); dependability on external funding (Cerqueiro, Hegde, Penas, & Seamans, 2016); Market uncertainty (Blind et al., 2017), type (upstream vs. downstream) (Chakraborty & Chatterjee, 2017); Regulation type (environmental, social vs. institutional regulation) (Blind, 2012)
Project/ Team	Positive and negative	***Cognitive:*** Specified search boundaries* (Rosso, 2014)	Firm's organizational dynamics (e.g. open communication, collaboration, managerial support, trust etc.) (Rosso, 2014)
Individual	Positive, negative, nonsignificant and inverted U-shaped	***Cognitive:*** Deviation from Path-of-Least-Resistance* (Moreau and Dahl, 2005)	Employees' need for cognition (Medeiros et al, 2014)

*Denotes presence of empirical evidence

Figure 1

Integrative Framework