WHEN LESS IS MORE: EXPLORING THE ANTECEDENTS OF
ENTREPRENEURIAL BRICOLAGE AND ITS INNOVATION IMPLICATION

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ABSTRACT OF THE DISSERTATION

WHEN LESS IS MORE: EXPLORING THE ANTECEDENTS OF ENTREPRENEURIAL BRICOLAGE AND ITS INNOVATION IMPLICATION

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In this dissertation, I begin with three goals. First, I seek to extend the bricolage-innovation relationship by considering the role of resource constraints. Second, I aim to explore the influence of bricolage on entrepreneurial orientation (EO). Third, I seek to assess how individual-level factors affect bricolage in the resource-constrained environment. To realize these goals, I conducted three studies that led to three essays.

The first essay’s purpose is to extend the relationship between bricolage and innovation. Based on the literature that connects resource constraints and innovation as well as the literature that links bricolage and innovation, I added resource constraints as the antecedent of bricolage-innovation link. Different from prior studies that treat resource constraints as a one-dimensional variable, I operationalized it from two dimensions, namely knowledge constraints and financial constraints. I argued that knowledge constraints and financial constraints are triggers of innovation of new firms and that bricolage plays a full mediating role in these relationships. In addition, I also proposed different effects of parallel bricolage and selective bricolage on innovation. The survey data from 183 entrepreneurs showed that bricolage fully mediates the relationship...
between knowledge constraints and innovation and partially mediates the relationship between financial constraints and innovation.

The purpose of the second essay is to examine the influence of bricolage on EO. The literature of EO and bricolage suggests that bricolage might be related with EO. In particular, I investigated the influence of bricolage on the three components of EO, namely innovativeness, proactiveness, and risk-taking. The results suggested that bricolage is positively related to innovativeness, whereas bricolage is negatively related to risk-taking. However, bricolage was found no impact on proactiveness.

The third essay’s purpose is to examine the moderating effects of creativity cognitive style in the relationship between resource constraints and bricolage. Drawing on cognitive psychology research, I posited that entrepreneurs’ divergent thinking positively moderates the relationship between resource constraints and bricolage, whereas entrepreneurs’ convergent thinking negatively moderates this relationship. The results supported both hypotheses.

The practical implications and future research directions are discussed.
This dissertation is dedicated to my beloved family members: my wife Fan Fan, my daughter Olivia Shen, my father Youbu Shen, my mother Zhang Wen, my sister Xiaolin Shen, my father in law Jianming Fan, and my mother in law Liping Ning. Without their love and support, this dissertation would not be possible.
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INTRODUCTION

Innovation plays an important role in firms’ survival and development (Damanpour, 1991; Smith, Collins, & Clark, 2005). However, new firms are usually confronted with their limited resources in their innovation process. Some scholars have suggested that new firms have trouble innovating because they lack existing knowledge (Cohen & Levinthal, 1990) and resources (Teece, 1986). Despite their limited resources, it is interesting and exciting to see that new firms are important entities that generate innovations. In some cases, they are even more innovative than established firms (Katila & Shane, 2005; Prusa & Schmitz, 1991). What factors enable new firms to be innovative under resource scarcity? To understand innovation of new firms with limited resources, some scholars have looked at the role of bricolage, which is defined as making do by applying combinations of the resources at hand to new problems and opportunities (Baker & Nelson, 2005). Research on entrepreneurial bricolage can address an important theoretical gap in the literature as founders and their organizations are increasingly working to resolve challenging problems and opportunities without the benefit of additional resources (Baker & Nelson, 2005). As such, bricolage behavior may predict entrepreneurs’ attempts to bring innovations to the marketplace to solve meaningful problems and challenges.

Indeed, for new firms with limited resources, entrepreneurial bricolage could be an important pathway to innovation because it allows firms to creatively recombine resources for which they were not originally designed (Baker & Nelson, 2005; Katila & Shane, 2005; Senyard, Baker, Steffens, & Davidsson, 2014). The theory of recombinative innovation suggests that resource recombination is expected to bring innovative outcomes
Likewise, Baker & Nelson (2005) suggest that “the process of combining resources for new purposes sometimes serves as a mechanism driving the discovery of innovations in the form of new ‘services’ from existing resources” (p. 335). Therefore, resource-constrained firms may achieve innovations by engaging in bricolage behaviors. For instance, Senyard et al. (2014) documented that bricolage can lead to a higher level of firm innovativeness in terms of new product, process, marketing methods, and target marketing selection. Gundry, Kickul, Griffiths, and Bacq (2011) demonstrated that bricolage positively affect social entrepreneur’s catalytic innovation. In addition, Salunke, Weerawardena, and McColl-Kennedy (2013) found a positive relationship between bricolage and supportive service innovation. These referred studies, among others, have evidenced that bricolage can sometimes promote innovations.

To understand how resource-constrained firms innovate, another stream of literature examines how resource constraints per se may influence firm innovation. In a conventional perspective, abundant or slack resources are regarded as preconditions of the success of innovation (e.g., Damanpour, 1991; Mone, McKinley, & Barker, 1998). Similarly, resource based view also indicates that valuable and inimitable resources are key for firm performance, such as innovation (Barney, 1991). Although these views are commendable for explaining the success of innovation, scholars are increasingly interested to explore whether resource constraints could drive innovations (Gibbert, Hoegl, & Valikangas, 2014).

Giddens (1984) argued that resource constraints have a dual role. On one hand, it may inhibit innovation. On the other hand, it may enable innovation under certain conditions.
Indeed, a newly emerging literature has examined the enabling side of resource constraints and argued that resource constraints could be triggers of innovation (e.g., Gibbert & Scranton, 2009; Gibbert & Valikangas, 2004; Hoegl, Gibbert, & Mazursky, 2008; Katila & Shane, 2005; Keupp & Gassmann, 2013). This vein of research holds the idea that “less is more” and argues that resource constraints can stimulate entrepreneurs to adopt creative behaviors to achieve the innovation outcomes (Moreau & Dahl, 2005). In this regard, resource constraints is not the inhibitor of innovation but rather the enabler of it (Keupp & Gassmann, 2013). In other words, new firms can generate innovations because of, not despite of, resource constraints (Gibbert, Hoegl, & Valikangas, 2007).

However, this stream of literature has not explicitly explored the mechanisms through which the resource constraints are translated to innovation outcomes. It should be safe to state that resource constraints are not likely to generate innovations automatically (Gibbert et al., 2014). Certain behaviors need to be taken to translate resource constraints to innovation outcomes. Therefore, it might be fruitful to integrate the literature that connects bricolage and innovation and the literature that links resource constraints and innovation to better understand innovations of new firms with resource constraints. By integrating these two streams of literature, in the first essay I added resource constraints as the antecedent of bricolage-innovation link. Bricolage behaviors are likely to occur in the resource-constrained environment (Baker & Nelson, 2005). Thus, resource constraints might trigger bricolage behaviors. In addition, as discussed above, resource constraints might facilitate innovations. Taken together, it could be expected that resource constraints may act as antecedent of bricolage-innovation link.
Different from prior studies that treat resource constraints as a one-dimensional variable, I operationalized it from two dimensions, namely knowledge constraints and financial constraints. I argue that knowledge constraints and financial constraints are triggers of innovation of new firms and that bricolage plays a full mediating role in these relationships. In addition, I also discussed how selective and parallel bricolage might play different roles in affecting innovation. By doing so, the first essay serves to extend the relationship between bricolage and innovation by considering resource constraints as an antecedent of this link and by looking at the effects of different forms of bricolage on innovation. Further, it also seeks to contribute to the literature on the relationship between resource constraints and innovation by examining the missing mechanism in this relationship.

The second essay attempts to investigate the influence of bricolage on EO. The literature of EO and bricolage suggests that theoretical linkages between bricolage and EO might exist. Indeed, EO has been considered a key strategy of organizational transformation through new combination of organization resources (Alvarez & Busenitz, 2001; Dess, Lumpkin, & McKee, 1999). Firms with EO go beyond the possible limits of currently available resources and believe that needed resources can be recombined (Bradley, Wiklund, & Shepherd, 2011). EO firms are likely to pursue opportunities by reconfiguring their existing resources and combining resources with complementary assets (Wu, 2007). Alvarez and Busenitz (2001) stated that entrepreneurial firms have a central capability to recognize opportunities and efficiently reorganize resources to generate heterogeneous outputs. This feature of EO inherently corresponds with the key
mechanism of bricolage—making do by recombining resources at hand. Therefore, I expect that bricolage might be related with EO.

Indeed, bricolage might influence each dimension of EO. First, bricolage may sometimes bring innovation outcomes (Baker & Nelson, 2005; Salunke et al., 2013; Senyard et al., 2014). Therefore, engaging in bricolage behaviors might drive firm’s innovativeness posture, which enables firms to pursue their innovation goals. Second, bricolage might create an environment that triggers proactiveness posture of a firm because bricoleurs have a bias for action in a way that they choose refusal to enact limitations on existing resources (Phillips & Tracey, 2007) by proactively recombining their existing resources at hand. This feature of bricolage corresponds with that of proactiveness, through which firms proactively seek and reorganize resources (Lumpkin & Dess, 1996). Further, bricolage might play a role in influencing risk-taking because making do with existing resources (bricolage) may involve risks (Baker & Nelson, 2005). Though a theoretical linkage between bricolage behaviors and EO could be expected, it is surprising that few studies have examined the potential relationships between them. The second essay seeks to fill this gap by examining the effect of bricolage on EO. In terms of the state of art, many scholars consider EO as a multidimensional variable (Dai, Maksimov, Gilbert, & Fernhaber, 2014; Kreiser, Marino, & Weaver, 2002; Rauch, Wiklund, Lumpkin, & Frese, 2009). Therefore I followed this lead and explored the relationship between bricolage and the sub-dimensions of EO (i.e., innovativeness, proactiveness, and risk-taking) respectively.

Given the potential link between bricolage and innovation (e.g., Gundry et al., 2011; Salunke et al., 2013; Senyard et al., 2014), in the third essay I am interested to explore
what factors may drive bricolage behavior. Indeed, a scan of relevant literature reveals that extensive attention has been devoted to the outcomes of bricolage (e.g., Garud & Karnøe, 2003; Halme, Lindeman, & Linna, 2012; Senyard et al., 2014; Senyard, Baker, & Steffens, 2010; Stenholm & Renko, 2016). However, relatively little research has been done to unravel the antecedents of bricolage (Stenholm & Renko, 2016). This represents a significant gap in the bricolage research because we still know little about the origins of bricolage behaviors. This gap constrains our ability to understand questions such as why, with other conditions being equal, some firms engage in bricolage behavior, but some other firms do not. In addition, lacking the understanding of predictors of bricolage may hamper the endeavor to promote bricolage behaviors, which has been found to have a positive impact on many firm-level outcomes as shown earlier (e.g., Baker & Nelson, 2005; Senyard et al., 2014; Senyard et al., 2010). To fill this gap, the goal of the third essay is to investigate the predictors of bricolage. In particular, I looked at how individual-level factors interact with resource constraints to influence bricolage. In particular, I examine the moderating effects of creativity cognitive style in the relationship between resource constraints and bricolage.

It is worthwhile to mention that bricolage is a behavior that individuals such as firms’ owners, chief executive officers (CEOs), or managers execute (Baker & Nelson, 2005). Therefore, individual-level factors may play a role in the engagement of bricolage behavior. In the third essay I explore how entrepreneurs’ creativity cognitive style moderates the relationship between resource constraints and bricolage. Cognitive style is considered a determinant of individual behavior (Allinson, Chell, & Hayes, 2000). It refers to consistent individual differences in perceiving and solving problems (Armstrong,
Different cognitive styles may lead to different perceptions and behavioral tendencies when entrepreneurs face penurious environments (Cropley, 2006). Creativity cognitive style is defined as individual differences in perceiving, behaving, solving problems, taking decisions, and relating to others in the creative process (Chen, Chang, & Lo, 2015). Creativity cognitive style is expected to be associated with bricolage because bricolage is a form of behavior that inherently involves with recombining existing resources in creative ways (Baker & Nelson, 2005).

Divergent thinking and convergent thinking are the two components of creativity cognitive style (Chen et al., 2015). Divergent thinking involves producing multiple answers from available information (Runco & Acar, 2012). Divergent thinkers can make unexpected combinations and recognize connections among remote relations (Cropley, 2006). On the contrary, convergent thinking involves narrowing down the different alternatives and achieve a definite solution (Cropley, 2006). Basadur and Hausdorf (1996) argued that divergent thinking and convergent thinking can bring different behavioral tendencies. By following this lead, the third essay was done to investigate the different moderating effects of divergent thinking and convergent thinking on the relationship between resource constraints and bricolage. Particularly, I expected that divergent thinking has a positive moderation effect, whereas convergent thinking has a negative moderation effect in the relationship between resource constraints and bricolage. Please see Figure 1 for the whole model that was tested in the studies associated with all three essays.
Figure 1: The overall model in this dissertation
In this dissertation, I attempt to contribute to the theory and practice in the following ways. In terms of theory, first, my aim is to contribute to the ongoing endeavors that link resource constraints to firm innovation by empirically testing the effect of resource constraints on innovation and examining a theoretical mechanism (i.e., bricolage) by which resource constraints influence innovation of new firms. This helps to answer the question “when (i.e., under what conditions or with what innovation strategies) resource constraints constitute an enabler of innovation” (Gibbert et al., 2014). In addition, this study also helps to extend the literature on the relationship between bricolage and innovation by testing the resource constraints as an antecedent of this link. Second, I attempt to make contribution to the literature on the outcomes of bricolage by demonstrating that bricolage acts as an antecedent of EO. Third, I hope to make a contribution to the emerging literature of the antecedents of bricolage. This helps to enhance our scholarly understanding of what factors drive entrepreneurial bricolage behaviors in firms. It has important value for the bricolage theory because the origins of bricolage behaviors have remained poorly understood in the existing literature (Stenholm & Renko, 2016).

With regard to practice, first, I hope to provide evidence on how new firms with resource constraints realize their innovation goals. Given that many new firms face the challenge of resource scarcity (Katila & Shane, 2005) and that innovation is crucial for the survival and development of new firms (Damanpour, 1991; Smith et al., 2005), the findings of this study are expected to benefit new firms that endeavor to achieve innovation goals. In particular, the findings of this study will shed light on how firms cope with knowledge constraints and financial constraints to achieve their innovation
goals. Second, I hope this study will contribute to practice by helping entrepreneurs to identify the factors that influence bricolage, which may, in turn, affect firm performance. Therefore, entrepreneurs could intentionally engage in bricolage behaviors when such behavior is needed for a firm’s growth. Third, this study also aims to identify the predictor (i.e., bricolage) of EO, thus providing evidence on how to drive EO in new firms. As EO has been found to have positive impact on firm performance (e.g., Anderson & Eshima, 2013; Barringer & Bluedorn, 1999; Covin & Lumpkin, 2011; Covin & Miller, 2014; Rauch et al., 2009; Wang & Juan, 2015), the findings could shed light on how new firms improve their firm performance in the resource-constrained environment.

The reminder of this dissertation includes three essays and an overall concluding remark. What follows next is essay one, which examines how resource constraints influence innovation.
Essay One: Resource Constraints and Innovation: When Less is More?

INTRODUCTION

New firms are important entities that generate innovations despite the resource-constrained environment that most of them face. In some cases, they are even more innovative than the large and established firms are (Katila & Shane, 2005; Prusa & Schmitz, 1991). What factors enable new firms to be innovative under resources scarcity? To understand innovation of new firms with resource constraints, some scholars have looked at how resource constraints per se may influence firm innovation. The conventional perspective suggests that abundant or slack resources are regarded as important drivers of innovation (e.g., Damanpour, 1991; Mone et al., 1998). The dominant logic here is that resource slack and a certain degree of freedom are needed to enable innovation (Damanpour, 1991). For instance, it has been argued that resources can support activities in innovation, such as experimentation, idea generation and selection, collaboration with suppliers, and market survey (Hoegl et al., 2008). In fact, the management literature predominantly considers constraints as inhibitors rather than enablers of innovation. Therefore, many prior works seek to understand how to conquer the limitation of resource constraints or minimize their negative effects on innovation (Blau, Pekny, Varma, & Bunch, 2004; Damanpour, 1991).

Although it is commendable to argue that resource constraints are inhibitors of innovation, another view suggests that resource constraints essentially have a dual nature (Giddens, 1984). It may play an inhibiting as well as an enabling role when it comes to
innovation. Psychology and creativity literatures have provided conceptual and experimental evidence for the fact that individuals are more creative when faced with a resource-constrained environment (Finke, Ward, & Smith, 1992; Moreau & Dahl, 2005). By inhibiting conventional responses to a problem and promoting unusual and unexpected ones (Burroughs & Glen Mick, 2004), resource scarcity sometimes can enhance creativity (Gibbert & Scranton, 2009; Goldenberg, Lehmann, & Mazursky, 2001; Moreau & Dahl, 2005), which has long been argued as a predictor of innovation (Sarooghi, Libaers, & Burkemper, 2015). Further, firms with limited resources are likely to leverage them more efficiently and creatively, thus increasing the probability to generate innovative outcomes (Starr & MacMillan, 1990).

Indeed, a newly emerging literature point out that resource constraints could drive innovation under certain conditions (e.g., Gibbert & Scranton, 2009; Gibbert & Valikangas, 2004; Hoegl et al., 2008; Katila & Shane, 2005; Keupp & Gassmann, 2013). This vein of research holds the idea that “less is more” and “necessity is the mother of innovation” and believes that resource constraints could stimulate entrepreneurs to adopt creative behaviors to achieve the innovation outcomes (Katila & Shane, 2005; Moreau & Dahl, 2005). In this regard, resource constraints is not the inhibitor of innovation but the enabler of it (Keupp & Gassmann, 2013). In other words, new firms can generate innovations because of, not even despite of, resource constraints. Differentiating the wording “because of” from “despite of” is necessary because “because of” indicates that resource constraints per se can facilitate innovation, whereas the prior literature focused on “despite of” by arguing how firms can conquer or minimize the effects of resource constraints to achieve innovations (e.g., Blau et al., 2004; Hargadon & Sutton, 1997;
Senyard et al., 2014). In fact, extant research has provided some evidence that resource constraints can sometimes promote innovation. Keupp and Gassmann (2013), for example, found that resource constraints are direct triggers of radical innovation. Further, some studies in the new product development literature found that resource-constrained projects can sometimes lead to products that are highly innovative (Goldenberg et al., 2001; Moreau & Dahl, 2005).

Though resource constraints may sometimes promote innovations, it is unlikely that resource constraints will automatically lead to innovation outcomes. Otherwise firms with fewer resources will always outperform firms with more resources in innovations, which is not a reasonable argument. As Gibbert et al. (2014) stated, *poverty is an extreme form of resource constraints, and the poorest are not the most innovative*. Therefore, a fruitful approach might be to look at when (i.e., under what conditions or with what innovation strategies) resource constraints constitute an enabler of innovation (Gibbert et al., 2014; Katila & Shane, 2005).

In a similar vein, to understand innovation of resource-constrained firms, another stream of literature has examined the role of bricolage, which is defined as making do by applying combinations of the resources at hand to new problems and opportunities (Baker & Nelson, 2005). For new firms with limited resources, entrepreneurial bricolage could be a viable pathway to innovation because it allows firms to creatively combine resources for which they were not originally designed (Baker & Nelson, 2005; Katila & Shane, 2005; Senyard et al., 2014). Resource recombination is expected to bring innovative outcomes (Henderson & Clark, 1990; Keupp & Gassmann, 2013; Nelson & Winter, 2009). Therefore, resource-constrained firms can sometimes achieve innovations by
engaging in bricolage behaviors. Indeed, the extant research has evidenced that bricolage can sometimes facilitate innovation. For example, Senyard et al. (2014) documented that bricolage can lead to a higher level of firm innovativeness. The results of that study did not support the competing hypothesis that “too much” bricolage will interfere with new firms’ ability to innovate. That is, with limited exceptions, they observed only positive effects of bricolage on innovation. In addition, Salunke et al. (2013) found a positive relationship between bricolage and supportive service innovation. Further, in the context of social entrepreneurship, Gundry et al. (2011) demonstrated that bricolage positively affect social entrepreneur’s catalytic innovation. This stream of literature has provided empirical evidence that firms can achieve innovation outcomes by engaging in bricolage behaviors.

However, the literature on the relationship between bricolage and innovation has overlooked the role of resource constraints, which may exert influence on bricolage as well as innovation. Resource constraints may trigger bricolage behaviors since bricolage is likely to occur in the resource-constrained environment (Baker & Nelson, 2005). As discussed earlier, resource constraints may stimulate a variety of novel practices, such as recombination, to meet the challenges that firms face (Schulze & Hoegl, 2006). Cognitive psychology research has suggested that people are more creative to solve problems under conditions of resource scarcity (Durham, Locke, Poon, & McLeod, 2000; Moreau & Dahl, 2005). Thus, entrepreneurs may be pushed to seek novel resource recombination when faced resource constraints (Bradley et al., 2011). For example, Mosakowski (2002) stated that firms with limited resources are more likely to make do with whatever resources at hand to launch innovation strategies and pursue firm goals. Therefore, resource
constraints are expected to trigger bricolage behaviors. Furthermore, as earlier discussed, resource constraints may sometimes facilitate innovation (e.g., Gibbert & Scranton, 2009; Gibbert & Valikangas, 2004; Hoegl et al., 2008; Katila & Shane, 2005; Keupp & Gassmann, 2013). Taken together, resource constraints might act as the antecedent of the bricolage-innovation link.

As such, it might be useful to integrate the literature that connects bricolage and innovation and the literature that links resource constraints and innovation. Based on these two streams of literature, this paper seeks to extend the understanding of the bricolage-innovation link by adding resource constraints as the antecedent of this link. Although bricolage behaviors are supposed to occur in the resource-constrained environment (Baker & Nelson, 2005), the empirical test between resource constraints and bricolage is little. There is evidence showing that large companies that are not resource-constrained also sometimes engage in bricolage behaviors (e.g., Halme et al., 2012). This raises question that whether resource constraints indeed trigger bricolage behaviors. Therefore it is needed to empirically test the relationship between resource constraints and bricolage. Similarly, the empirical test between resource constraints and firm innovation is rare either. In addition, as stated earlier, prior literature about resource constraints and innovation ignored the mechanism in this relationship (e.g., Keupp & Gassmann, 2013). Taken together, one of the goals of this study was to address these gaps by empirically testing the relationship between resource constraints and bricolage and between resource constraints and firm innovation in the context of new firms. As such, the potential contribution of this essay lies in how I extend the relationship between
bricolage and innovation as well as the relationship between resource constraints and innovation.

In addition, I also expected different effects of parallel bricolage and selective bricolage on firm innovation. According to Baker and Nelson (2005), parallel bricolage and selective bricolage are two different forms of bricolage. In parallel bricolage, firms engage multiple ongoing projects relying on bricolage simultaneously. In selective bricolage, firms apply bricolage only in limited areas of firms’ operation. In the literature, surprisingly few studies have explored the effect of both forms of bricolage on outcome variables. In this paper, I will address this gap by examining the effects of parallel bricolage and selective bricolage on one form of outcome--innovation. I believe this endeavor can help to draw a more complete picture about how bricolage influences innovation. Baker and Nelson (2005) proposed that selective bricolage may enable firms to grow, whereas parallel bricolage may limit firms’ growth. Following this lead, I expect selective bricolage to have a positive impact on innovation, whereas parallel bricolage will have a negative one on innovation. Please see Figure 2 for the conceptual model of this paper.

The aim of this study was to make the following contributions. First, it adds knowledge to the ongoing endeavors that link resource constraints to firm innovation by empirically testing the effect of resource constraints on innovation outcomes through bricolage. It hopes to extend the literature on the relationship between bricolage and innovation by addressing the extent to which bricolage behavior mediates the relationship between resource constraints and innovation of new firms. It also aims to fills the missing link between resource constraints and innovation. Second, it hopes to contribute to the
innovation literature by unraveling the mechanisms by which new firms with limited resources achieve their innovation goals. Therefore, the findings of this study could complement the views suggesting that abundant or slack resources are necessary for firm innovation. Third, it provides practical implications for firms with limited resources by showing them how to conquer resource constraints and realize their innovation goals.

THEORY AND HYPOTHESES

Key Constructs

Entrepreneurial bricolage

Bricolage was originally introduced by Levi-Strauss (1966), who basically contrasted the actions of engineers and those of bricoleurs—those who utilize bricolage. Whereas engineers perform their work by gathering tools and materials for an intended design, bricoleurs choose to use “whatever is at hand.” Specifically, Levi-Strauss (1966) considered bricolage to be the process that people use to combine the various resources they have at hand as a means of finding workable approaches to problems and opportunities. It focuses on addressing opportunities and problems with existing undervalued or discarded resources that are often available for free or cheaply (Desa & Basu, 2013). Since its original conception, bricolage has been invoked in a wide range of social science disciplines, such as social psychology (Weick, 1993), innovation research (Ciborra, 1996; Garud & Karnøe, 2003), and entrepreneurship studies (Baker, Miner, & Eesley, 2003). It has also gained increasing attention in management and organization studies (Duymedjian & Rüling, 2010; Perkmann & Spicer, 2014). In the entrepreneurship literature, bricolage is defined as making do by applying combinations of the resources at hand to new problems and opportunities (Baker & Nelson, 2005). Specifically, entrepreneurs enact bricolage in the following five domains: (1) physical inputs—
imbuing forgotten, discarded, worn, or presumed single-application materials with new use-value; (2) labor inputs—involving customers, suppliers, and hangers-on in providing work on projects; (3) skill inputs—permitting and encouraging the use of amateur and self-taught skills that would otherwise go unnoticed or unexploited; (4) customers/markets—providing products or services that would otherwise be unavailable; and (5) institutional and regulatory environment—refusing to enact limitations with regard to many “standards” and regulations, and by actively trying things in a variety of areas in which entrepreneurs either do not know the rules or do not see them as constraining (Baker & Nelson, 2005; Fisher, 2012).

Bricolage assumes a social constructionist view of an organization's environment (Baker and Nelson, 2005). It emphasizes that entrepreneurs do not simply accept the limitations set upon them but instead show critical agency in enacting their environments (Weick, 1988). Extant work on bricolage in entrepreneurship focuses on the enactment of resource environments, asking how it is possible that some entrepreneurs are able to create something out of nothing (Baker, 2007; Baker & Nelson, 2005; Di Domenico, Haugh, & Tracey, 2010). Bricolage has been generally studied in the context of small and medium-sized companies. Recently, intrapreneurial bricolage, defined as entrepreneurial activity within a large organization characterized by the creative bundling of scarce resources, was also discussed (Halme et al., 2012). For instance, Halme et al. (2012) illustrated empirically how intrapreneurial bricolage helps innovators to overcome organizational constraints and to mobilize internal and external resources. They found that intrapreneurial bricolage is of fundamental importance in MNC innovation for inclusive business.
The consequences of bricolage have been widely examined in the literature (e.g., Garud & Karnøe, 2003; Halme et al., 2012; Senyard et al., 2014; Senyard et al., 2010; Stenholm & Renko, 2016). Among these studies, some of them have evidenced a positive link between bricolage and innovation. Senyard et al. (2014), for instance, found that bricolage is positively related to firm innovativeness in terms of new product, process, marketing methods, and target marketing selection. It is worthwhile to mention that they proposed two competing hypotheses in that study, contrasting the effect of bricolage on innovativeness. The results did not support the hypothesis that “too much” bricolage will interfere with new firms’ ability to innovate. That is, with limited exceptions, they observed only positive effects of bricolage on innovation. The study by Salunke et al. (2013) found a positive relationship between bricolage and supportive service innovation. In the context of social entrepreneurship, Gundry et al. (2011) found that bricolage positively affect social entrepreneur’s catalytic innovation. These studies have provided empirical evidence that firms can achieve innovation outcomes by engaging in bricolage behaviors.

The current essay bases on these works and attempts to extend the bricolage-innovation link.

**Parallel bricolage**

Parallel bricolage and selective bricolage are two forms of bricolage (Baker & Nelson, 2005). Firms practicing parallel bricolage make something from nothing by making do in the following domains: physical inputs, labor, skills, customers, and the institutional environment (Baker & Nelson, 2005). One of the major features of parallel bricolage is that firms engaging in parallel bricolage make do with their existing resources.
consistently and repeatedly across multiple domains simultaneously. In extreme cases, some firms exhibit bricolage in all activities of the firm’s operation (Senyard et al., 2014). Moreover, most parallel bricoleurs continue to engage in bricolage after the projects are completed. It has been argued that parallel bricolage may restrict the firm growth. Baker and Nelson (2005) found that most of the firms engaged in parallel bricolage have limited growth or no growth. Although parallel bricolage was proposed to exert influence on firm growth, empirical evidence about the influence of parallel bricolage on firm-level outcomes remains little. Thus, the aim of this paper is to fill this gap by exploring how parallel bricolage affects innovation.

**Selective bricolage**

In contrast, firms engaging in selective bricolage make do with the existing resources in only one or a few aspects of a firm’s operation. They ‘*reject bricolage in some or even all domains and thereby avoided becoming constrained by the demands of embedded ties and an organizational identity defined by bricolage*’ (Baker & Nelson, 2005). Unlike parallel bricolage, selective bricolage was found to facilitate firm growth (Baker & Nelson, 2005). However, the mechanism of how selective bricolage drives firm growth is not clear. One possible mechanism might be through innovation. In the form of selective bricolage, firms generate innovative solutions through bricolage but then advance those solutions by rejecting the further use of bricolage and adopting more standard innovation practices (Senyard et al., 2014). Surprisingly, the empirical works about the influence of selective bricolage on innovation remain little. This paper addresses this gap by examining the impact of selective bricolage on innovation.
**Resource constraints**

Generally speaking, resource constraints describe situations where no sufficient resources exist for firms to solve problems or pursue opportunities (Gibbert et al., 2007). It is opposed to resource adequacy or slack. Regarding the relationship between resource constraints and innovation, Cyert and March (1963) were among the first to speculate whether resource constraints stimulates innovation. Giddens (2013) pointed out that constraints have dual role. It could be an inhibitor as well as an enabler when it comes to innovation. Indeed, the effect of constraints on innovation is typically assumed to be a negative one. For example, a widespread notion is that resource adequacy or slack are drivers of innovation (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Camisón-Zornoza, Lapiedra-Alcamí, Segarra-Ciprés, & Boronat-Navarro, 2004; Damanpour, 1991; Gassmann & Zedtwitz, 2003). The dominant logic here is that resources and a certain degree of freedom are needed to enable innovation (Damanpour, 1991).

However, some other scholars have argued that resources constraints could enable creativity (Gibbert & Scranton, 2009; Goldenberg et al., 2001; Moreau & Dahl, 2005) and innovation (Burgelman, 1983; Katila & Shane, 2005; Starr & MacMillan, 1990; Stokes, 2009; Ward, 2004) under certain conditions. Psychology and creativity literatures have provided conceptual and experimental evidence for the fact that individuals are more creative when faced with a resource-constrained environment (Finke et al., 1992; Moreau & Dahl, 2005). Resource scarcity sometimes can enhance creativity, which has long been argued as a predictor of innovation (Sarooghi et al., 2015), by inhibiting conventional responses to a problem and promoting unusual and unexpected ones (Burroughs & Glen Mick, 2004). Further, firms with limited resources are likely to
leverage them more efficiently and creatively, thus increasing the probability to generate innovative outcomes (Starr & MacMillan, 1990).

Some empirical works have shown that resource constraints can promote innovations. Katila and Shane (2005), for instance, explored the relationship between resource constrains and innovation performance and specified the environmental contingent variables in this relationship. They proposed that new firms with limited resources have higher rates of innovation in markets that are more competitive, are smaller, and have plentiful financial resources. Likewise, Moreau and Dahl (2005) found that consumers are more innovative when given limited resources to solve an innovation problem. Similarly, by analyzing four cases in jet propulsion development, Gibbert and Scranton (2009) demonstrated that resource constraints trigger the innovation outcomes. Keupp and Gassmann (2013) found that knowledge constraints and financial constraints can enable radical innovation.

This paper will follow this stream of literature by testing the effect of resource constraints on innovation through bricolage. I particularly focus on knowledge constraints and financial constraints because both knowledge and finance of firms are closely related with firm innovation (Amabile, 1988; Damanpour, 1991; Katila & Ahuja, 2002; Shane & Cable, 2002). Therefore, the lack of knowledge and financial resources might affect firm innovation. By adopting Keupp and Gassmann (2013), in this paper, I define knowledge constraints as the degree of lacking internal and external knowledge means to solve problems or pursue opportunities. Similarly, financial constraint is defined as the degree of lacking internal and external financial means to solve problems or pursue opportunities.
Firm innovation

In line with prior research, innovation is defined as the introduction of a new product, process or service to the marketplace (Edwards & Gordon, 1987; Katila & Shane, 2005). Innovation enhances new firms’ competitive advantages and plays key role in new firms’ survival and development (Audretsch, 1991; Cefis & Marsili, 2006; Smith et al., 2005). Such significance encourages me to explore the factors that might influence the innovation of new firms with limited resources.

Hypothesis Development

Resource constraints as enabler of innovation

A widespread notion in the literature is that abundant or slack resources facilitate innovation (e.g., Camisón-Zornoza et al., 2004; Damanpour, 1991; Mone et al., 1998). The argument is that resources are needed to support activities in innovation, such as experimentation, idea generation and selection, collaboration with suppliers, and market survey (Hoegl et al., 2008). Although these views are reasonable, one should note that adequate resources, as opposed to limited resources, might not always be the enabler of innovation. Prior research suggests that firms with adequate resource availability tend to avoid experimentation and are likely to search for opportunities along their known technological domains rather than exploring new opportunities (Bradley et al., 2011). With abundant resources, firms have limited incentives to take risks and experiment because they tend to focus on internal efficiency rather than the discovery and exploration of new opportunities (Cheng & Kesner, 1997; Miller & Leiblein, 1996). Therefore, firms with excess resources can sometimes fail to generate innovations because innovation requires firms to take risks and explore novel opportunities (Levinthal & March, 1993).
In contrast, a more recent perspective suggests that innovation can be efficiently developed due to resource constraints (Gibbert et al., 2007; Gibbert & Scranton, 2009; Keupp & Gassmann, 2013). As Giddens (2013) pointed out, resource constraints have a dual role. It could be an inhibitor as well as an enabler when it comes to innovation. Resource constraints can promote innovation under certain conditions or with certain innovation strategies (Gibbert et al., 2014). Perceptions of resource scarcity may stimulate some novel activities, such as recombination (Schulze & Hoegl, 2006), which, in turn, may promote innovation. In addition, cognitive psychology literature suggests that individuals will be more creative to solve problems under conditions of resource scarcity (Moreau & Dahl, 2005). The reason could be that the human mind is more productive when restricted. With constraints limiting them, people are more likely to come up with unexpected ideas (Gibbert et al., 2007). This line of reasoning indicates that entrepreneurs may recognize more creative solutions to innovation problems when under the pressure of resource constraints.

The extant literature has provided some theoretical and empirical evidence about the positive effect of resource scarcity on innovation. Katila and Shane (2005), for instance, explored the relationship between resource constraints and innovation performance and specified the environmental contingent variables in this relationship. They proposed that new firms with limited resources have a higher rate of innovation in markets that are more competitive, smaller, and with plentiful financial resources. Likewise, the literature in psychology and creativity also demonstrated that resource scarcity might promote creativity and innovation (e.g., Moreau & Dahl, 2005; Ward, 2004). For instance, Moreau and Dahl (2005) found that consumers are more innovative when given limited resources
to solve an innovation problem. As stated above, the reason could be that individuals who have to solve an innovation problem are more creative under condition of resource constraints (Durham et al., 2000). Similarly, analyzing four innovation cases under resource constraints in the history, Gibbert and Scranton (2009) concluded that sources of innovation can be “because of the constraints” and “despite of the constraints”.

Regardless the “because of” or “despite of,” what I can infer from this finding is that resource constraints could be enabler, not inhibitor, of innovation.

Following the lead of Keupp and Gassmann (2013), this paper will particularly address the influence of two types of resources constraints—knowledge constraints and financial constraints—on innovation of new firms. I adopted these two types of constraints because both knowledge and finance are important factors that may influence firm innovation (Amabile, 1988; Damanpour, 1991; Katila & Ahuja, 2002).

It is difficult for firms to seek innovation-related knowledge because this type of knowledge is often highly special and dependent on specific firm routines and prior search paths (Carlile, 2004). In this circumstance, the scarcity of knowledge resource may trigger the exploration of knowledge elements by creatively recombinining knowledge that already exists in the organization (Gibbert & Scranton, 2009). The recombinative innovation research suggests that the reuse and recombination of existing knowledge elements in novel ways is expected to generate innovative outcomes (Damanpour, 1991; Fleming & Sorenson, 2004; Henderson & Clark, 1990; Katila & Ahuja, 2002). In addition, innovation teams that under knowledge constraints are expected to better leverage the diverse knowledge and skills of all team members (Hoegl et al., 2008), thus increasing the probability that the firm can develop innovations. For example, in the
post–World War II era, German teams under resource constraints won American teams with greater access to resources in a race to resolve the jet engine performance dilemma by creatively leveraging and combining their existing knowledge elements (Gibbert et al., 2007).

In a similar vein, firms that face financial constraints may be forced to make do with their limited financial resources and undertake more entrepreneurial innovation activities (Hoegl et al., 2008). The X-efficiency theory in the economics literature suggests that firms are necessarily inefficient in the allocation of resources (Leibenstein, 1976). Resource constraints literature suggests that firms with fewer resources are likely to leverage them more efficiently (Starr & MacMillan, 1990). In particular, firms with limited financial resources are likely to increase the efficiency of resource allocation because their limited financial resources will not allow them to explore all possible innovations (Keupp & Gassmann, 2013; Mosakowski, 2002). Thus, financial resource constraints may force entrepreneurs to improve allocative efficiency and seek novel resource recombination (Bradley et al., 2011; George, 2005), which, in turn, positively influence the generation of innovation. For example, Hewitt-Dundas (2006) found that financial constraints are positively related to the likelihood of innovation because financial constraints appear to act as a stimulus to innovation success.

On the other hand, firms with financial constraints may be also forced to seek external financial support. Some new firms with financial constraints may engage in the activities, such as venturing (Wadhwa & Kotha, 2006) and open innovation (Chesbrough, Vanhaverbeke, & West, 2006). Such activities are expected to increase the innovative outcomes of firms. Taken together, activities that financial constraints stimulate, such as
exploiting existing financial resources efficiently or acquiring external resources creatively, may trigger innovation outcomes.

**Resource constraints as antecedent of bricolage-innovation link**

The discussion above suggests that resource constraints (i.e., knowledge constraints and financial constraints) are potential enablers, rather than inhibitors, of firm innovation. However, resource constraints may not be a direct predictor of innovation success (Gibbert & Valikangas, 2004). If so, new firms with fewer resources will outperform their counterparts with more resources, which is not a plausible argument. To fully understand the constraints-innovation link, it is necessary to identify mechanisms that may account for this relationship. As earlier stated, the literature linking bricolage and innovation has overlooked the role of resource constraints. Though prior articles assume that resource constrains are trigger of bricolage behaviors, little research has empirically tested this relationship. On the other hand, the literature connecting resource constraints and innovation have ignored the mechanisms that how resource constraints promote innovation (Keupp & Gassmann, 2013). Therefore, it might be helpful to integrate both streams of literature to understand how resource constraints influence innovation in new firms. By integrating these two streams of literature, I expected resource constraints to be antecedent of bricolage-innovation link. Bricolage will fully mediates the relationship between resource constraints and firm innovation. The rationale for this argument is as follows.

**Resource constraints and bricolage**

When facing resource constraints in innovation, firms have three options: avoiding new challenges and doing nothing; resource seeking to ease the resource constraints directly;
or making do by applying combinations of the resources at hand (Baker & Nelson, 2005).
Seeking external resources is difficult for most new firms (Shane & Cable, 2002). Doing nothing might be a viable option under certain circumstances. It may, however, cause firms to miss opportunities. Therefore, making do with existing resources at hand might be an alternative behavior that new firms adopt when they face resource constraints. My interest in this paper is not in the creative processes of easing resource constraints but in successfully working under such constrained conditions.

As discussed earlier, resource constraints may stimulate a variety of novel practices, such as recombination, to meet the challenges that firms face (Schulze & Hoegl, 2006). As cognitive psychology research has suggested, people are more creative to solve problems under conditions of resource scarcity (Durham et al., 2000; Moreau & Dahl, 2005). Thus, entrepreneurs may be pushed to seek novel resource recombination when faced resource constraints (Bradley et al., 2011). For example, Mosakowski (2002) stated that firms with limited resources are more likely to make do with whatever resources at hand to launch innovation strategies and pursue firm goals. This line of reasoning suggests that resource constraints, conceptualized as knowledge constraints and financial constraints in this paper, is expected to trigger bricolage behavior.

**Bricolage and innovation**

Bricolage has been found to have positive impact on innovation in several studies (e.g., Gundry et al., 2011; Salunke et al., 2013; Senyard et al., 2014). Senyard et al. (2014) have provided a thorough discussion about how bricolage facilitates innovation. In their paper, they proposed two competing hypotheses. They hypothesized that bricolage has a positive as well as a negative effect on innovation. The results suggested that bricolage
positively affects innovation and that “too much” bricolage exerts no negative effect on innovation, which further confirms the positive role that bricolage plays on innovation. In this paper, I based on Senyard et al. (2014) study and other related works that linked bricolage and innovation and expect that bricolage will have a positive influence on innovation of new firms. As such, the novelty of the current essay does not come from the argument of bricolage-innovation link, but comes from how I extend this existing relationship in the literature.

For new firms with limited resources, entrepreneurial bricolage could be an important pathway to innovation because it allows firms to creatively combine resources and generate innovative solutions (Baker & Nelson, 2005; Katila & Shane, 2005; Senyard et al., 2014). Resource recombination is expected to bring innovative outcomes (Henderson & Clark, 1990; Keupp & Gassmann, 2013; Nelson & Winter, 2009). In addition, the novel combinations of nonstandard resources can sometimes generate brilliant unforeseen outcomes, such as innovations (Levi-Strauss, 1966). Further, firms engaging in bricolage behaviors can create heterogeneous value from resources available cheaply or for free. This may enable new firms that do more bricolage to generate more innovations than new firms that do less bricolage because bricolage allows the former to make creative use of limited resources to generate more values from the resources at hand.

Further, compared with the firms that decline to pursue innovation goals due to limited resources, firms engaging in bricolage have more possibilities of generating innovative outcomes because they choose to overcome resource constraints that would otherwise prevent them from developing innovative solutions (Fisher, 2012). Indeed, the extant literature has evidenced that bricolage can sometimes promote innovation. As earlier
stated, Salunke et al. (2013) found a positive relationship between bricolage and supportive service innovation. Further, Gundry et al. (2011) demonstrated that bricolage positively affect social entrepreneur’s catalytic innovation. Consistent with the existing literature, I also expect that bricolage will positively affect innovation. Based on the discussion above, I proposed the following hypotheses:

_Hypothesis 1.1:_ Knowledge constraints (1.1a) and financial constraints (1.1b) are positively related to bricolage.

_Hypothesis 1.2:_ Bricolage is positively related to firm innovation.

_Hypothesis 1.3:_ Bricolage fully mediates the relationship between knowledge constraints (1.3a) / financial constraints (1.3b) and firm innovation.

**The different effects of parallel bricolage and selective bricolage on innovation**

Two forms of bricolage exist: parallel bricolage and selective bricolage (Baker & Nelson, 2005). In the form of parallel bricolage, firms engage multiple ongoing projects relying on bricolage simultaneously. In extreme cases, some firms exhibit bricolage in all activities of the firm’s operation (Senyard et al., 2014). Moreover, most parallel bricoleurs continue to engage in bricolage after the projects are completed. In contrast, firms engaging in selective bricolage make something from nothing in only one or a few aspects of a firm’s operation. They reject engaging in bricolage after the projects are completed. It was found that parallel bricolage and selective bricolage may have different impacts on firm growth. In their observation on 29 firms in a field study,
Baker and Nelson (2005) found that most firms that engaged in parallel bricolage have limited growth or even no growth, while most firms practicing selective bricolage have satisfactory growth. This is a very interesting finding that has inspired me to explore the possible different effects of parallel bricolage and selective bricolage on firm-level variables, such as innovation. In this study, I expected that parallel and selective bricolage may also have different effects on firm innovation. Specifically, in the paper, I argue that parallel bricolage has a negative impact on firm innovation, whereas selective bricolage has a positive influence on firm innovation.

Parallel bricolage and innovation

Firms practicing parallel bricolage make something from nothing by making do in the following domains: physical inputs, labor, skills, customers, and the institutional environment (Baker & Nelson, 2005). In each domain, firms engaged in parallel bricolage use resources that others ignore or do not intend to use. One of the major features of parallel bricolage is that firms engaging in parallel bricolage make do with their existing resources consistently and repeatedly across multiple domains simultaneously. Parallel bricolage sometimes can be a trap for firms, as Baker and Nelson (2005) argued, because using bricolage consistently and repeatedly across multiple domains simultaneously may impede the development of organizational focus and routines that might support growth and profitability (Baker & Nelson, 2005). As a result, firms engaging in parallel bricolage have limited growth or no growth (Baker & Nelson, 2005). Indeed, among all of the observations in Baker and Nelson’s (2005) study, none of the firms that engaged in parallel bricolage grew. As far as innovation, I also expect that parallel bricolage may hinder firm innovation. Rationales for this argument are discussed below.
First, the indiscriminate use of bricolage may prevent firms adopting standard innovation practices and routines that might support innovation. As said above, parallel bricoleurs engage in bricolage consistently and repeatedly in almost all of the activities in the firm. This may result in many potentially innovative yet temporary solutions for problems or opportunities (Senyard et al., 2014). Although these temporary solutions could be working for each particular case, they are not likely to be developed into innovations because parallel bricoleurs are lack of the inclination to standardize and improve the temporary solutions to innovations (Senyard et al., 2014). Moreover, bricolage is often accomplished through improvisation (Miner, Bassof, & Moorman, 2001). Therefore, parallel bricolage is likely to result in too many improvisations, which may lead to a number of substandard outcomes (Miner et al., 2001). For example, temporary solution A works for case A and temporary solution B works for case B. Parallel bricoleurs do not have the intention of transforming both temporary solutions into standardized and high-level practices that can apply to all cases. We may call these temporary solutions as creative solutions. However, they are not innovations and can hardly be developed into innovations because they are substandard and parallel bricoleurs do not intend to improve these solutions.

Second, making do by applying the existing resources in every aspect of the firm’s operation may lead to the waste use of resources, which may impede the generation of innovation. Among all of the simultaneously operated projects in parallel bricolage, some projects inevitably cannot be completed. Resources invested in these half-completed projects are not used efficiently and effectively towards solving problems or pursuing opportunities. In fact, as Senyard et al. (2014) stated, the assumption that firm can make
do in every aspect of the operation may lead to many inefficient and repetitive activities, which are resource wasteful and might not be helpful for the generation of innovation. As said, most of the new firms are resource constrained (Katila & Shane, 2005). Therefore, it is vital for new firms to use limited resources in an effective way to generate positive outcomes, such as innovations. The ineffective tinkering efforts resulting from parallel bricolage will make it difficult for new firms to generate innovations (Levi-Strauss, 1966).

Third, parallel bricolage does not allow entrepreneurs to pay focused attention to problems or opportunities. As parallel bricoleurs engage in bricolage consistently and repeatedly in almost all of the activities in the firm, they can hardly focus on one or a few domains. This may constrain firm’s ability to achieve satisfactory outcomes in many aspects, such as innovations. As Baker and Nelson (2005) suggested, engaging in multiple projects is time consuming and requires lots of attention for the processes of learning, experimentation, and fabrication. In this way, parallel bricoleurs spread their efforts too thin (Senyard et al., 2014), providing no focus on discovery or exploitation of opportunities for innovation. Taken together, I hypothesized the following:

_Hypothesis 1.4a: Parallel bricolage is negatively related to firm innovation_

Selective bricolage and innovation

Firms engaging in selective bricolage make something from nothing in only one or a few domains of activity and in limited time. They apply bricolage more judiciously. According to Baker & Nelson’s (2005) observation in their field study, most of the firms
that engaged in selective bricolage have satisfactory growth. As far as innovation, I argue that selective bricolage has a positive impact on firm innovation for the following reasons.

First, selective bricolage allows firms to adopt standard innovation practices and routines that may support innovation. Most selective bricoleurs tend to reject using the bricolage once the problems are solved or the opportunities are realized (Baker & Nelson, 2005). Instead, they standardize the incipient creative practices adopted in the bricolage process. The standardized creative practices may continuously guide other activities in the firm. By routinely using the creative practices, firms are expected to generate incremental innovations to its current products or services. Moreover, the recombination of resources in one or a few domains can sometimes generate radical innovations (Keupp & Gassmann, 2013).

Second, the concentrate efforts in one or a few areas are critical to the firm’s innovation. Innovation is a complex process that requires focused and accumulated efforts (Wu, Chang, & Chen, 2008). Unlike parallel bricolage, selective bricolage allows firms to focus on one or a few areas. In this way, firms can concentrate and make focused efforts to solve problems. The focused efforts make it possible to accumulate knowledge and innovative solutions in domains where bricolage is applied. The accumulated knowledge and innovative solutions have the potential to be advanced to innovation outcomes (Damanpour, 1991). Indeed, among all of the field observations in Baker and Nelson’s (2005) study, most of the innovative firms are those that adopt selective bricolage.

Third, selective bricolage allows firms to use limited resources in an efficient way on activities that may have higher chances to generate positive results, such as innovations.
Firms engage in bricolage usually because they are resource constrained. It is necessary for such firms to use the limited resources in an efficient and smart way. Otherwise, it would be hard for them to achieve the intended goals, such as innovations. Selective bricolage allows firms to focus on solving problems in one or a few domains so that they are more likely to use their resources selectively and efficiently than engaging in bricolage in multiple domains simultaneously. In addition, selective bricoleurs choose certain domains to apply bricolage judiciously. Perhaps they tend to choose domains they think they are good at or have more knowledge about so that they know better how to use the resources to achieve the strategic goals of the firm. As Baker and Nelson (2005) stated, selective bricolage allows “resources to go to areas that senior managers viewed as strategic”. Such areas may have higher chances to generate innovations than areas that are not strategically important for firms.

Finally, in some cases, selective bricolage allows firms successively investigate and develop innovations in an exploratory way (Senyard et al., 2014). By focusing only on one or a few domains, selective bricoleurs are able to develop innovations in an exploratory way and may generate incremental innovations for their current products or services. Unlike parallel bricolage, selective bricolage allows firms to pay focused attention and accumulated efforts to the selected domains. By focusing their attention on limited areas, selective bricoleurs may have more time and chances to explore new ways of solving problems or pursuing opportunities. In addition, they can dig deeper on the selected domains and explore different solutions, so that it may be more likely for them to come up with some high-level innovative outcomes rather than some substandard solutions. Therefore, I expected the following:
**Hypothesis 1.4b:** Selective bricolage is positively related to firm innovation

**Figure 2: Conceptual Model of Essay 1**

**METHOD**

**Sample and Procedure**

For the purpose of this study, one criterion for selecting sample firms was that the firms should be in the resource-constrained context. Compared with the established firms, new firms are usually confronted with resource scarcity (Shepherd, Douglas, & Shanley, 2000). Therefore, in this study, I collected data from new firms, which are defined as firms of eight years of age or younger (Atuahene-Gima & Li, 2004). I collected data from ReferenceUSA, a database that includes verified and accurate information (such as the business name, founders’ or managers’ contact information, sales volume, firm size, and
year established) of more than 14 million US firms. This database is developed through more than 20 million phone calls to firms per year and is updated monthly (Baron & Tang, 2011; Kalleberg, Marsden, Aldrich, & Cassell, 1990). Collecting data from ReferenceUSA in management and entrepreneurship research is a common practice (e.g., Baron & Tang, 2011; Baron, Tang, & Hmieleski, 2011; Egan, Yang, & Bartlett, 2004; Hao & Song, 2016).

The data were collected in the year of 2017. All of the firms in the sample were founded between the year of 2009 and 2016. The sample firms were randomly chosen from a wide range of industries, including agriculture, forestry and fishing, construction, manufacturing, transportation and communications, wholesale trade and retail trade, insurance, and real estate. A pilot study aimed at testing the face and content validity of measurements was conducted before the main data collection took place. I obtained 27 responses from the pilot study, and these firms were excluded from the final sample. After that, I sent emails to a random sample of 1,000 new ventures; each email included a structured questionnaire, an explanation of the research project, a confidentiality promise, and an encouragement that each participating firm would receive a report of the findings when the study was completed. I sent 1,000 emails because a review of recent studies that involved collecting survey data in the similar way showed that the response rate was approximately 20% (e.g., Foley, Ngo, & Loi, 2012; Hmieleski & Baron, 2009; Wang & Bansal, 2012). With 1,000 surveys, I figured I may be able to get around 200 usable responses, which was sufficient for data analysis in this dissertation.

Before I sent out the emails, I called the respondents to confirm their email addresses and invited them to participate in the study. After that, emails were directly sent to the top
management leaders (i.e., founders, managers, or CEOs) of each firm who showed interest in this study. Top management leaders are appropriate respondents because they are the most knowledgeable individuals with respect to their firms’ strategies, actions, and innovation performance (Sharfman, 1998; Sine, Mitsuhashi, & Kirsch, 2006). Reminders were sent three weeks after the initial emails were sent out. In the end, I received 198 responses (19.8% response rate), including 161 early responses from the first round emails and 37 late responses from the second round. After withdrawing 15 incomplete responses, I had 183 usable responses in the end. As Armstrong and Overton (1977) suggested, I assessed the non-response bias by comparing the early and late respondents in terms of the mean values of the study variables and by comparing the mean responses of the respondents and non-respondents in terms of firm age, firm size, and sales revenue. The results suggested no non-response bias. To further check the non-response bias, I also ran a paired comparison to test if significant differences existed in firm age, size, and sales revenue between the firms that agreed to participate in this study and those that did not. As shown in Table 1.1, the results indicate no significant differences in firm age, size, or sales revenue between the firms that agreed to participate in this study and those that did not (t=0.47 for age; t=0.62 for size; t=0.43 for sales revenue, not significant), further validating that no non-response bias was found in this study.
Table 1.1: Paired Comparison Test between Firms That Agreed To Participate and Those That Did Not Agree To Participate This Study

<table>
<thead>
<tr>
<th>Variable</th>
<th>Firms that agreed to participate</th>
<th>Firms that did not agree to participate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>1. Firm size</td>
<td>37.93</td>
<td>22.83</td>
</tr>
<tr>
<td>2. Firm age</td>
<td>5.32</td>
<td>2.06</td>
</tr>
<tr>
<td>3. Revenue</td>
<td>4.12</td>
<td>1.36</td>
</tr>
</tbody>
</table>

$N=183$

Table 1.2 shows the basic characteristics of the sample firms. These characteristics include industry, firm age, firm size, and annual revenue. Among others, 40.4% of the sample firms are in the manufacturing industry. Firms between five to eight years old account for 65.6% of the total sample; 85.7% of the firms have 60 employees or fewer; and 57.4% of the firms have annual revenues of $1.5 million to $2.5 million.
Table 1.2: Characteristics of Sample Firms

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture, Forestry and Fishing</td>
<td>5</td>
<td>2.7</td>
</tr>
<tr>
<td>Construction</td>
<td>17</td>
<td>9.3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>74</td>
<td>40.4</td>
</tr>
<tr>
<td>Transportation and Communications</td>
<td>20</td>
<td>10.9</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>24</td>
<td>13.1</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>20</td>
<td>10.9</td>
</tr>
<tr>
<td>Insurance, Insurance and Real Estate</td>
<td>15</td>
<td>8.2</td>
</tr>
<tr>
<td>Services</td>
<td>7</td>
<td>3.8</td>
</tr>
<tr>
<td>Non-classifiable</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Firm age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2</td>
<td>15</td>
<td>8.2</td>
</tr>
<tr>
<td>3-4</td>
<td>48</td>
<td>26.2</td>
</tr>
<tr>
<td>5-6</td>
<td>77</td>
<td>42.1</td>
</tr>
<tr>
<td>7-8</td>
<td>43</td>
<td>23.5</td>
</tr>
<tr>
<td><strong>Firm size (number of employees)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-30</td>
<td>82</td>
<td>44.8</td>
</tr>
<tr>
<td>31-60</td>
<td>75</td>
<td>40.9</td>
</tr>
<tr>
<td>61-90</td>
<td>22</td>
<td>12.0</td>
</tr>
<tr>
<td>&gt;90</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Annual revenue (USD, millions)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;0.5</td>
<td>20</td>
<td>10.9</td>
</tr>
<tr>
<td>0.5-1.0</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>1.0-1.5</td>
<td>31</td>
<td>16.9</td>
</tr>
<tr>
<td>1.5-2.0</td>
<td>56</td>
<td>30.6</td>
</tr>
<tr>
<td>2.0-2.5</td>
<td>49</td>
<td>26.8</td>
</tr>
<tr>
<td>&gt;2.5</td>
<td>23</td>
<td>12.6</td>
</tr>
</tbody>
</table>

N=183

Measurement

Measurements were adapted from the extant literature. For parallel bricolage and selective bricolage, no existing measurements could be found in the literature. Thus, I designed the measurements for these two constructs and tested the reliability and validity in a pilot study. A five-point Likert scale was used for the measurements of the constructs (except for firm innovation). A five-point Likert scale was chosen because it would reduce the frustration levels of respondents and increase the response rates and response
quality (Dawes, 2008; Sachdev & Verma, 2004). Respondents were asked to rate their agreement for each statement from 1 (totally disagree) to 5 (totally agree). Please see the Appendix for the measurement items for each construct.

**Dependent variable**

Firm innovation

Firm innovation is defined as the introduction of a new product, process or service to the marketplace (Edwards & Gordon, 1987; Katila & Shane, 2005). The sample included firms from various industries. Firms in different industries may have different forms of innovation. For example, the innovation of manufacturing industry may primarily come from new products. However, the innovation of service industry may mainly come from new services. Therefore, the measurement of firm innovation needed to capture different types of innovation. I used the number of new products, services, processes, and technologies that the firm developed to measure the firm's innovation (Kochhar & David, 1996). A higher number of new products, services, processes, and technologies reflect superior innovation performance (Chaney & Devinney, 1992). This measurement captures the possible types of innovations of firms in different industries. It has been widely used in other studies (e.g., Katila & Ahuja, 2002; Kickul & Gundry, 2002; Liu, Gong, Zhou, & Huang, 2017).

**Independent variables**

Bricolage

Bricolage is defined as making do by applying combinations of resource at hand for new problems and opportunities (Baker & Nelson, 2005). It was measured with eight items that captured behaviors related to acting based on scarce resources at hand. The measurements reflected the three core mechanisms of bricolage: “make do,”
“recombining resource at hand,” and “new problems and opportunities.” The respondents were asked how they recombine existing resources at hand when they face new problems or opportunities. Senyard et al. (2014) first introduced the scale and Davidsson et al. (2017) validated it. It was proved to have high reliability and validity in other studies (e.g., Stenholm & Renko, 2016; Wu, Liu, & Zhang, 2017). One sample item is “We are confident of our ability to find workable solutions to new challenge by using our existing resources.” All items were measured on a Likert scale ranging from 1 = totally disagree to 5 = totally agree. The composite reliability for the bricolage measurement was 0.954, which showed very good internal consistency (Hair, Anderson, Babin, & Black, 2010). The Cronbach’s alpha for bricolage scale was 0.957, indicating a high level of reliability (Cronbach, 1951).

Parallel bricolage

Firms engaging in parallel bricolage make do with their existing resources consistently and repeatedly across multiple domains simultaneously (Baker & Nelson, 2005). No existing measurements were found for parallel bricolage in the literature. Thus, I designed the measurements for this construct by reflecting the definition of parallel bricolage in Baker and Nelson’s (2005) paper. The measurements capture the key feature of parallel bricolage, that is, firms consistently and repeatedly apply bricolage across multiple domains simultaneously. The three items are: (1) We deal with problems or opportunities by using existing resources in all of the activities in our firm. (2) We make do with our existing resources to new problems and opportunities and keep doing this after the problems are solved or the opportunities are realized. (3) We consider our ability to make do with our existing resources in all of the activities in our firm to be a positive
identity. All items were measured on a Likert scale ranging from 1 = totally disagree to 5 = totally agree. The composite reliability for the parallel bricolage scale was 0.917, and the Cronbach’s alpha for this measurement was 0.909, indicating good reliability (Cronbach, 1951; Hair et al., 2010).

Selective bricolage

In selective bricolage, firms engage bricolage in only one or a few domains of firms’ operation (Baker & Nelson, 2005). To my knowledge, no measurements exist for selective bricolage in the extant literature. Therefore, I also created the measurements for this construct. The measurements were designed to reflect the key features of selective bricolage, that is, firms engage bricolage in only one or a few domains of firms’ operation. The three items are: (1) We deal with problems or opportunities by using our existing resources in one or a few aspects of firm’s operation. (2) Once the problems are solved or the opportunities are realized, we will reject the practice of making do by using our existing resources. (3) We standardize the practice we learn in the process of making do with existing resources. All items were measured on a Likert scale ranging from 1 = totally disagree to 5 = totally agree. The composite reliability for the selective bricolage scale was 0.891, showing good internal consistency (Hair et al., 2010). The Cronbach’s alpha for this measurement was 0.877, indicating acceptable reliability (Cronbach, 1951).

Knowledge constraints

Knowledge constraints were defined as the degree of lacking internal and external knowledge means to solve problems or pursue opportunities. The measurement for knowledge constraints was adapted from Keupp and Gassmann (2013). It captured the key feature of knowledge constraints that firms lack the necessary knowledge-related
resources, such as research and development (R&D) staff, needed for innovation goals. One sample item for knowledge constraints is “My firm is missing R&D staff that is needed to accomplish our innovation objectives.” All items were measured on a Likert scale ranging from 1 = totally disagree to 5 = totally agree. The composite reliability for the knowledge constraints scale was 0.916, and the Cronbach’s alpha for this measurement was 0.867, indicating good reliability (Cronbach, 1951; Hair et al., 2010).

Financial constraints

Financial constraints were defined as the degree of lacking internal and external financial means to solve problems or pursue opportunities. Likewise, the measurement for financial constraints was also adapted from Keupp and Gassmann (2013). It captured the key feature of financial constraints that firms lack the necessary finance-related resources, such as external financial means, needed for innovation goals. One sample item is “My firm is missing the external financial means to accomplish our innovation objectives.” All items were measured on a Likert scale ranging from 1 = totally disagree to 5 = totally agree. The composite reliability for the financial constraints scale was 0.916, and the Cronbach’s alpha for this measurement was 0.814, indicating good reliability (Cronbach, 1951; Hair et al., 2010).

Control variables

To rule out the alternative explanations, a set of control variables were included in the analysis.

Firm age. Firm age has long been argued to have an impact on innovation (Coad, Segarra, & Teruel, 2016; Hansen, 1992; Huergo & Jaumandreu, 2004). Older firms are expected to leverage more of their existing technological competencies, whereas younger
firms are expected to experiment more with new technologies (Sørensen & Stuart, 2000). Additionally, older firms may have more access to resources (Lederman, 2010), which are needed to support activities in innovation, such as experimentation, idea generation and selection, collaboration with suppliers, and a market survey (Hoegl et al., 2008). Therefore, I controlled for firm age, which was measured as the number of years since the firm was founded (De Clercq, Dimov, & Thongpapanl, 2010).

Firm size. Firm size may influence firm innovation (Hansen, 1992). Firm size can both positively or negatively influence the innovation output (Teece, 1992). Compared with smaller firms, larger firms have more financial means and resources to invest in innovation-related activities (Damanpour, 1992). However, small firms sometimes are more innovative than large firms (Prusa & Schmitz, 1991). Therefore, I controlled for firm size, which was measured by using the natural log of firm’s number of employees (Bellamy, Ghosh, & Hora, 2014).

Revenue. I also controlled for revenue because it might also affect firm innovation. Firms with more revenue have higher capability of investing in innovation-related activities, such as R&D, which may influence innovation output (Wan, Ong, & Lee, 2005). Revenue was measured with the revenue of the respondent’s business in the last fiscal year.

Industry competitiveness. Innovation may help firms to survive and develop in the competitive environment (Cefis & Marsili, 2006; Smith et al., 2005). Therefore, firms in competitive industries may have more pressure to innovate than firms in less competitive industries do (Solleiro & Castañón, 2005). I controlled for industry competitiveness, which was measured by asking the respondents to select the most appropriate
descriptions of their industries from not competitive to extremely competitive (Zhou, Yim, & Tse, 2005).

**Analytical Strategy**

I used structural equation modeling (SEM) to conduct data analysis in this paper. SEM is an analytical tool that combines confirmation factor analysis, regression, and path analysis. It has the ability to (1) estimate multiple and interrelated dependence relationships; (2) represent latent variables in these relationships; (3) consider measurement errors in estimation; and (4) define a model explaining an entire set of relationships (Xiong et al., 2014). SEM is an appropriate analysis tool in this study because this model features latent variables and multiple regressions. One common rule for implementing SEM is that it should have a minimum threshold of 100 subjects (Burnette & Williams, 2005). In this study, I had 183 respondents, which was adequate for the data analysis. Before I tested the hypothesized relationships, I first tested the reliability and validity of the measurements. To test the full mediation effect, I compared the fit of the full mediation model with that of the alternative partial mediation model. I followed the recommendation of James, Mulaik, and Brett (2006) that full mediation represents the best choice of a baseline model. If the partial mediation model does not provide a better fit to the data than the full mediation model does, then the full mediation model should be retained (James et al., 2006). The statistics programs used were SPSS (19.0) and Amos (17.0).
Pilot Study

Prior to mailing the respondents, I conducted a pilot study to detect any ambiguities in terms, meanings, and issues with the questionnaire. First of all, I invited three PhD colleagues who majored in entrepreneurship to review the measurements. Minor changes were made to the measurements according to their feedback. “My firm lacks the internal financial means” was changed to “My firm is missing the internal financial means to accomplish our innovation objectives” to better capture the meaning of financial constraints. Subsequently, I distributed the questionnaires to 27 small business owners and/or managers and asked them to fill out the questionnaire and identify if any ambiguous terms or sentences were present in the survey. No changes were made according to their feedback. The Cronbach’s alpha was run to test the reliability of the measurements. The Cronbach’s alpha for each variable ranged from 0.773 to 0.858. Specifically, Cronbach’s alpha was 0.857 for knowledge constraints, 0.836 for financial constraints, 0.809 for selective bricolage, 0.853 for parallel bricolage, and 0.807 for bricolage. The Cronbach’s alpha for knowledge constraints (0.857) and financial constraints (0.836) are comparable to those of Keupp and Gassmann (2013), where Cronbach’s alpha for knowledge constraints and financial constraints were 0.782 and 0.875 respectively. The Cronbach’s alpha for bricolage (0.807) is comparable to that of Senyard et al. (2014), where Cronbach’s alpha for bricolage was 0.820. Because the numbers were all greater than the threshold of 0.7 (Cronbach, 1951), it should be safe to conclude that the measurements had adequate reliability. After these steps were done in the pilot study, the measurements of the constructs had acceptable face and content validity and could be distributed to the large sample for the hypothesis test.
**Factor Analysis**

An EFA was performed to confirm the underlying factor structure. The results of the EFA with principal component extraction and Varimax rotation resulted in a five-factor solution. The five factors explained 80.09% of the variance, and each factor had an Eigenvalue greater than 1. As shown in Table 1.3, all items are significantly loaded on their associated factors, and no high cross loadings can be seen, suggesting all variables had adequate discriminant validity (Hair et al., 2010).
Table 1.3: Exploratory Factor Analysis

<table>
<thead>
<tr>
<th>Model construct</th>
<th>Measurement item</th>
<th>Varimax-rotated loadings factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Selective bricolage</td>
<td>sel1</td>
<td>.257</td>
</tr>
<tr>
<td></td>
<td>sel2</td>
<td>.265</td>
</tr>
<tr>
<td></td>
<td>sel3</td>
<td>.186</td>
</tr>
<tr>
<td>Parallel bricolage</td>
<td>para1</td>
<td>-.219</td>
</tr>
<tr>
<td></td>
<td>para2</td>
<td>-.271</td>
</tr>
<tr>
<td></td>
<td>para3</td>
<td>-.360</td>
</tr>
<tr>
<td>Knowledge constraints</td>
<td>knlg1</td>
<td>.175</td>
</tr>
<tr>
<td></td>
<td>knlg2</td>
<td>.203</td>
</tr>
<tr>
<td></td>
<td>knlg3</td>
<td>.165</td>
</tr>
<tr>
<td></td>
<td>knlg4</td>
<td>.234</td>
</tr>
<tr>
<td>Financial constraints</td>
<td>fin1</td>
<td>.302</td>
</tr>
<tr>
<td></td>
<td>fin2</td>
<td>.224</td>
</tr>
<tr>
<td>Bricolage</td>
<td>brico1</td>
<td>.802</td>
</tr>
<tr>
<td></td>
<td>brico2</td>
<td>.831</td>
</tr>
<tr>
<td></td>
<td>brico3</td>
<td>.827</td>
</tr>
<tr>
<td></td>
<td>brico4</td>
<td>.829</td>
</tr>
<tr>
<td></td>
<td>brico5</td>
<td>.834</td>
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<tr>
<td></td>
<td>brico6</td>
<td>.840</td>
</tr>
<tr>
<td></td>
<td>brico7</td>
<td>.817</td>
</tr>
<tr>
<td></td>
<td>brico8</td>
<td>.756</td>
</tr>
</tbody>
</table>

Sum of squares (eigenvalue) 9.731 2.111 1.933 1.237 1.007
Cumulative variance explained (%) 30.310 45.361 58.329 71.045 80.094

Bolded numbers are factor loadings for each component.
a. Rotation converged in 5 iterations.
The software program Amos 17.0 was used to test the validity of the measurement model by conducting CFA. As shown in Table 1.4, the value of the comparative fit index (CFI), incremental fit index (IFI), and Tucker-Lewis index (TLI) are all greater than the threshold of 0.9. The value of root mean square error of approximation (RMSEA) is lower than the threshold of 0.08. Specifically, the values are as follows: $\chi^2(155) = 217.059$ ($p < .001$); $\chi^2/df = 1.40$; CFI = 0.981; IFI = 0.981; TLI = 0.977; RMSEA = 0.047.

Therefore, the measurement model showed acceptable fit.

The convergent validity of the constructs was established using item loadings and their significance. As shown in Table 1.4, the factor loadings of items on their respective constructs, ranging from 0.621 to 0.980, are all greater than the suggested minimum of 0.5 and are statistically significant, suggesting that the constructs have convergent validity (Bagozzi & Yi, 1988). Next, I compared the correlation between every pair of constructs and the square root of the average variance extracted (AVE) of each variable. The discriminant validity of the constructs can be established if the AVE for one construct is greater than the absolute values of the standardized correlations of the given construct with any other construct (Fornell & Larcker, 1981). In Tables 1.4 and 1.5, discriminant validity is evident because the correlation between every pair of constructs is below the square root of the average variance extracted from each variable.

Reliability was established by referring to Cronbach’s $\alpha$ (Cronbach, 1951) and composite reliability (Bagozzi & Yi, 1988). The Cronbach’s $\alpha$ for each construct ranges from 0.814 to 0.957, exceeding the required minimum of 0.7. In addition, the composite reliability value for each construct ranges from 0.891 to 0.954, above the suggested
minimum of 0.7. Altogether, these results demonstrated the validity and reliability of the measurement model.

By looking at Table 1.3, 1.4, and 1.5, what I can infer from the results is that parallel bricolage and selective bricolage are two different variables from bricolage. As shown in Table 1.3, no high cross-loadings exist among the items of parallel bricolage, selective bricolage, and bricolage. This suggests that these three variables have adequate discriminant validity and are distinct from each other. Similarly, Table 1.4 and 1.5 also suggest that parallel bricolage, selective bricolage, and bricolage are three different variables because the correlation between every pair of variables is below the square root of the AVE from each variable (Fornell & Larcker, 1981).

These results were not in line with the conceptual meanings of parallel bricolage, selective bricolage, and bricolage. Conceptually, these three variables should have certain levels of convergence because parallel bricolage and selective bricolage are inherently two forms of bricolage. However, the test of discriminant validity suggests that these three variables are completely distinct from each other. Therefore, I conclude that the measurements of parallel bricolage and selective bricolage had not been able to successfully measure these two variables. That is, these measurements lack adequate validity. Thus I decided to drop parallel bricolage and selective bricolage out of the conceptual model of this paper due to the measurement issues. By doing this I attempted to ensure the results validity of this study.

Though this paper has failed to measure both selective bricolage and parallel bricolage, it is necessary to look at what the measures for both constructs might be capturing. In order to do so, I combined the measures of selective and parallel bricolage with the eight
items of bricolage overall to conduct a post hoc proxy of these constructs. This gave me 14 items in total. The Cronbach’s alpha for these measures is 0.769, suggesting adequate reliability. Next I ran factor analysis with the extraction method of principle factor analysis for these items. Before rotation, the 14 items barely fall into the same column, except for the second and third item from selective bricolage and the third item from parallel bricolage, which have low factor loadings (<0.5).

Then I removed the items with low factor loadings from selective bricolage and parallel bricolage. The removed items in selective bricolage are “Once the problems are solved or the opportunities are realized, we will reject the practice of making do by using our existing resources” and “We standardize the practice we learn in the process of making do with existing resources”. The removed item in parallel bricolage is “We consider our ability to make do with our existing resources in all the activities in our firm as a positive identity”. Then I reran the factor analysis for the retained 11 items. I found that the items fell into one column, suggesting they were measuring the same construct, which is bricolage.

The results show that the eight items for bricolage (Senyard et al., 2014) have relatively higher factor loadings, which range from 0.827 to 0.920, while the factor loadings for selective bricolage and parallel bricolage have lower factor loadings, which range from 0.586 to 0.652. What I can infer from this set of analysis is that: (1) the second and third item from selective bricolage and the third item from parallel bricolage were not essentially measuring bricolage, and (2) the retained items in both selective bricolage and parallel bricolage (along with the eight items from bricolage) were
measuring bricolage. However, they are weak measures for bricolage because factor loadings for these items are relatively low.

**Table 1.4: Confirmatory Factor Analysis for Measures**

<table>
<thead>
<tr>
<th>Constructs and Items</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Selective bricolage (α = .877; CR = .891; AVE = .736)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) We deal with problems or opportunities by making do with our existing resources in one or a few aspects of firm’s activities.</td>
<td>0.891</td>
</tr>
<tr>
<td>(2) Once the problems are solved or the opportunities are realized, we will discontinue the practice of making do by using existing resources.</td>
<td>0.963</td>
</tr>
<tr>
<td>(3) We standardize what we learn from the practice of making do with existing resources.</td>
<td>0.698</td>
</tr>
<tr>
<td><strong>Parallel bricolage (α = .909; CR = .917; AVE = .788)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) We deal with problems or opportunities by making do with our existing resources in all the activities in our firm.</td>
<td>0.868</td>
</tr>
<tr>
<td>(2) We make do with our existing resources to new problems and opportunities and keep doing this after the problems are solved or the opportunities are realized.</td>
<td>0.980</td>
</tr>
<tr>
<td>(3) We consider our ability to make do with existing resources in all the firm activities as a positive identity.</td>
<td>0.807</td>
</tr>
<tr>
<td><strong>Financial constraints (α = .814; CR = .916; AVE = .846)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) My firm is limited in external capital needed to accomplish our innovation objectives.</td>
<td>0.953</td>
</tr>
<tr>
<td>(2) My firm is limited in internal capital needed to accomplish our innovation objectives.</td>
<td>0.885</td>
</tr>
<tr>
<td><strong>Knowledge constraints (α = .867; CR = .916; AVE = .734)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) My firm is limited in staff that is needed to accomplish our innovation objectives.</td>
<td>0.866</td>
</tr>
<tr>
<td>(2) My firm is limited in staff that is needed to produce products or provide services.</td>
<td>0.948</td>
</tr>
<tr>
<td>(3) My firm is limited in technological knowledge that is needed to develop our products or services.</td>
<td>0.703</td>
</tr>
<tr>
<td>(4) My firm is limited in market knowledge that is needed to sell products or provide services into new markets.</td>
<td>0.890</td>
</tr>
</tbody>
</table>

**Bricolage (α = .957; CR = .954; AVE = .725)**

| (1) When we are facing new challenges we are confident in our ability to find workable solutions by using our existing resources. | 0.946 |
| (2) We willingly take on a broader set of challenges than our available resources allow us to do. | 0.940 |
| (3) When responding to a new problem or opportunity, we use any existing resource that seems useful for this purpose. | 0.876 |
| (4) We face new challenges by combining our existing resources with external resources that are available to us inexpensively. | 0.843 |
| (5) When dealing with new problems or opportunities, we consider using the existing resources as a workable solution. | 0.773 |
| (6) We take on a surprising variety of new challenges with the resources that we have. | 0.813 |
| (7) When we face new challenges, we prefer to create solutions from our existing resources rather than acquiring new resources. | 0.800 |
| (8) We combine resources to accomplish new challenges that the resources were not originally intended to accomplish. | 0.772 |

*Note. α = Cronbach’s α; AVE = average variance extracted; CR = composite reliability. Model fit statistics: χ²(155) =217.059 (p < .001); χ²/df=1.40; CFI = 0.981; IFI = 0.981; TLI = 0.977; RMSEA = 0.047. All factor loadings are significant at the .01 level.*
**Common method bias and multicollinearity**

Several procedures that Podsakoff, MacKenzie, Lee, and Podsakoff (2003) suggested were used to address the common method bias (CMV). First, in the beginning of the survey, I assured the respondents that no absolutely right or wrong answers existed in the survey and that they could withdraw from the survey anytime. This could help to limit the respondents’ concerns, such as evaluation apprehension and social desirability (Tang, Chen, & Jin, 2015). Second, I mixed the order between the measurements of IV and the measurements of DV to decrease the participants’ perceptions of any connection between IV and DV as well as between constructs (Fulmer, Barry, & Long, 2009). Finally, I used Harman (1976) one-factor post-hoc test to detect if CMV existed. The factors with eigenvalues greater than 1.0 accounted for 80.09% of the total variance. The largest factor did not account for a majority of the variance (30.31%). Thus, common method bias was unlikely to be a serious concern in this study.

The variance inflation factor for each independent variable was lower than the suggested threshold of 4, thus suggesting the absence of multicollinearity (Chatterjee & Hadi, 2015).

**RESULTS**

Table 1.5 provides the means, standard deviations, and correlations. The sample firms have 37.93 employees on average, with a minimum of five employees and a maximum of 145 employees. The firm age ranges from one year old to eight years old with a mean age of 5.32 years. The average revenue, measured as the revenue of the last physical year, is between $1.5 million and $2 million. The sample firms face relatively high
competitiveness with a mean score of 3.31. In addition, the sample firms have a moderate level of resource constraints with a mean score of 2.55 and 2.40 for knowledge constraints and financial constraints respectively. Furthermore, the mean score for bricolage is 2.59, indicating a moderate level of bricolage in the sample firms. This number indicates that many firms in the sample do not engage in bricolage behaviors. A closer look at the sample shows that the industries with an average bricolage score of more than 3 include manufacturing, construction, services, and retail trade, indicating that most of the firms in these industries engage in bricolage. The other industries, i.e., agriculture, forestry and fishing, transportation and communications, wholesale trade, insurance, and real estate have an average bricolage score lower than 3, indicating that most of the firms in these industries do not engage in bricolage. Finally, the mean score for innovation is 5.97.

Table 1.5: Means, Standard Deviations, and Correlations

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Firm size</td>
<td>37.93</td>
<td>22.83</td>
<td>.148*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Firm age</td>
<td>5.32</td>
<td>2.06</td>
<td></td>
<td>.148*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Revenue</td>
<td>4.12</td>
<td>1.36</td>
<td>.439**</td>
<td>.147*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Industry competitiveness</td>
<td>3.31</td>
<td>.93</td>
<td>.106</td>
<td>-.036</td>
<td>.066</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Knowledge constraints</td>
<td>2.55</td>
<td>.98</td>
<td></td>
<td>.131</td>
<td>.003</td>
<td>.043</td>
<td>.013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Financial constraints</td>
<td>2.40</td>
<td>1.28</td>
<td>.175*</td>
<td>.035</td>
<td>.069</td>
<td>.084</td>
<td>.620**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Bricolage</td>
<td>2.59</td>
<td>1.07</td>
<td>.046</td>
<td>.017</td>
<td>.003</td>
<td>.058</td>
<td>.564**</td>
<td>.629**</td>
<td></td>
</tr>
<tr>
<td>8. Innovation</td>
<td>5.97</td>
<td>5.95</td>
<td>.178*</td>
<td>.024</td>
<td>.029</td>
<td>.062</td>
<td>.543**</td>
<td>.596**</td>
<td>.545**</td>
</tr>
</tbody>
</table>

Note: N = 183.
*p < .05. **p < .01.

To test the mediation effect, I followed the SEM approach that James et al. (2006) suggested. A full mediating model should be tested from the independent variable (resource constraints) to the mediator (bricolage) and from the mediator (bricolage) to the
dependent variable (firm innovation). I compared the fit of the full mediation model with that of an alternative partial mediation model (Schneider, Ehrhart, Mayer, Saltz, & Niles-Jolly, 2005). If the partial mediation model does not have a better fit with the data, the full mediation model is the preferred model (James et al., 2006). The full mediation model includes three paths: two from the antecedent variables (knowledge constraints and financial constraints) to the mediator (bricolage) and one from the mediator to the outcome variable (firm innovation). The assumption in the full mediation model is that the antecedent variables have an indirect effect on outcome variables through the mediator. The partial mediation model added two paths to the full mediation model: one is from the knowledge constraints to firm innovation, and the other one is from financial constraints to firm innovation. The assumption in the partial mediation model is that the antecedent variables exert either direct or indirect influence on the outcome variables.

I first tested the mediation effect of bricolage in the relationship between knowledge constraints and innovation. Fit indices indicated that the full mediation model provided an acceptable fit to the data: \( \chi^2(109) = 180.906 \ (p < .001) \); \( \chi^2/df=1.660 \); CFI = 0.973; IFI = 0.973; TLI = 0.966; RMSEA = 0.060. The partial mediation also had a good fit to the data: \( \chi^2(108) = 155.674 \ (p < .001) \); \( \chi^2/df=1.441 \); CFI = 0.954; IFI = 0.960; TLI = 0.947; RMSEA = 0.065. However, the partial mediation model did not significantly improve the fit to the data: \( \Delta\chi^2 (df=1)=25.232, ns \). According to the rule of parsimony (James et al., 2006), the full mediation model was the preferred model. Additionally, the direct relationship between knowledge constraints and firm innovation was not found to be significant (\( \beta = 0.041; \ p >0.1 \)), further supporting the presence of full mediation. Therefore,
bricolage fully mediated the relationship between knowledge constraints and firm innovation.

Then, I tested the mediation effect of bricolage in the relationship between financial constraints and innovation. Fit indices indicated that the full mediation model provided an acceptable fit to the data: $\chi^2(109) = 178.983 (p < .001); \chi^2/df=1.627; \text{CFI} = 0.973; \text{IFI} = 0.974; \text{TLI} = 0.967; \text{RMSEA} = 0.059$. The partial mediation also had a good fit to the data: $\chi^2(108) = 155.674 (p < .001); \chi^2/df=1.441; \text{CFI} = 0.982; \text{IFI} = 0.982; \text{TLI} = 0.977; \text{RMSEA} = 0.049$. The partial mediation model provided a better fit with the data: $\Delta \chi^2 (df=1)=23.309, p < .001$. Additionally, the direct relationship between financial constraints and firm innovation was found to be significant ($\beta = 0.377; p <0.001$), further supporting the presence of partial mediation. Please see Figure 3 for the results of the hypothesis test.

**Test of hypotheses**

In hypothesis 1.1a, it was predicted that knowledge constraints are positively related to bricolage. As shown in the data analysis, a significant and positive relationship was found between knowledge constraints and bricolage ($\beta = 0.282; p<0.001$). Therefore, hypothesis 1.1a was supported.

In hypothesis 1.1b, it was proposed that financial constraints are positively related to bricolage. The results showed a positive and significant relationship between financial constraints and bricolage ($\beta = 0.444; p<0.001$), thereby providing support for hypothesis 1.1b.
In hypothesis 1.2, it was proposed that bricolage is positively related to innovation. As shown in the results, a positive and significant relationship was found between bricolage and innovation ($\beta = 0.357; p<0.01$). Therefore, hypothesis 1.2 was supported.

In hypothesis 1.3 it was predicted that bricolage fully mediates the relationship between resource constraints and innovation. As discussed above, this hypothesis was partially supported because bricolage fully mediated the relationship between knowledge constraints and innovation, whereas bricolage partially mediated the relationship between financial constraints and innovation.

In hypothesis 1.4a, it was predicted that parallel bricolage is negatively related to innovation. As stated above, parallel bricolage was removed from the conceptual model due to the measurement issue. Therefore I withdraw this hypothesis.

In hypothesis 1.4b, it was predicted that selective bricolage has a positive impact on innovation. Likewise, this hypothesis was also withdrawn due to the measurement issue of selective bricolage.
Figure 3: Results of Structural Equation Modeling

$N=183$

* $p < .05$; ** $p < .01$; *** $p < .001$

Fit index: $\chi^2(108) = 155.674$ ($p < .001$); $\chi^2/df = 1.441$; CFI = 0.954; IFI = 0.960; TLI = 0.947; RMSEA = 0.065.
Robustness checks
To further validate the results, I ran several robustness checks. First, I ran Poisson regression analysis because the dependent variable was count data (Cohen, Cohen, West, & Aiken, 2013). I followed Baron and Kenny (1986) procedure to examine the mediation effects: (1) the independent variable must significantly impact the dependent variable; (2) the independent variable must significantly impact the mediator; (3) the mediator must significantly impact the dependent variable; and (4) when the mediator enters the step (1) model, full mediation is supported if the originally significant influence of the independent variable on the dependent variable becomes insignificant; meanwhile, partial mediation requires the significance level of the impact of the independent variable to the dependent variable to decrease substantially. The data analysis for this new sample showed that the results for all of the hypotheses held. For hypothesis 1.1a, $\beta = 0.242$; $p<0.001$. For hypothesis 1.1b, $\beta = 0.347$; $p<0.001$. For hypothesis 1.2, $\beta = 0.509$; $p<0.01$. For hypothesis 1.3, both knowledge constraints and financial constraints were positively related to bricolage. Knowledge constraints ($\beta = 0.254$; $p<0.001$) and financial constraints ($\beta = 0.489$; $p<0.001$) were positively related to innovation. However, when the mediator (bricolage) was entered into the model, the originally effect size between financial constraints and innovation decreased ($\beta = 0.358$; $p<0.05$), and the originally significant relationship between knowledge constraints and innovation became nonsignificant ($\beta = 0.292$; $p>0.1$). In sum, the results suggested that bricolage partially mediates the relationship between financial constraints and innovation and fully mediates the relationship between knowledge constraints and innovation.
Then, I split the whole sample into several subsamples by firm age, size, and industry. Next, I ran SEM to see if the results still held. First of all, I excluded the firms that are relatively young (zero to one year of age) or old (seven to eight years of age) and got a new sample of 153 firms. The data analysis for this new sample showed that the results for all of the hypotheses held. For hypothesis 1.1a, $\beta = 0.267$; $p<0.001$. For hypothesis 1.1b, $\beta = 0.503$; $p<0.001$. For hypothesis 1.2, $\beta = 0.487$; $p<0.01$. For hypothesis 1.3, bricolage also fully mediated the relationship between knowledge constraints and innovation ($\chi^2(109) = 178.654$ ($p < .001$); $\chi^2$/df=1.639; CFI = 0.957; IFI = 0.960; TLI = 0.947; RMSEA = 0.064), whereas bricolage partially mediated the relationship between financial constraints and innovation ($\chi^2(108) = 184.368$ ($p < .001$); $\chi^2$/df=1.707; CFI = 0.967; IFI = 0.968; TLI = 0.954; RMSEA = 0.058).

Next, I excluded the firms that do not have 10 firms in an industry, thus giving me a new sample of 170 firms. The SEM analysis for this new sample showed that the results for all of the hypotheses still held. For hypothesis 1.1a, $\beta = 0.302$; $p<0.001$; For hypothesis 1.1b, $\beta = 0.288$; $p<0.001$; For hypothesis 1.2, $\beta = 0.458$; $p<0.01$. For hypothesis 1.3, bricolage also fully mediated the relationship between knowledge constraints and innovation ($\chi^2(109) = 192.785$ ($p < .001$); $\chi^2$/df=1.767; CFI = 0.960; IFI = 0.976; TLI = 0.954; RMSEA = 0.063), whereas bricolage partially mediated the relationship between financial constraints and innovation ($\chi^2(108) = 178.439$ ($p < .001$); $\chi^2$/df=1.652; CFI = 0.954; IFI = 0.967; TLI = 0.954; RMSEA = 0.062). Finally, I split the sample by their revenues. I excluded the firms with less than $0.5 million in annual revenue or more than $2.5 million in annual revenue. I got 140 firms in the new sample. Again, I ran SEM for this sample. The results for all of the hypotheses still held. For hypothesis 1.1a, $\beta = 0.254$;
p<0.001. For hypothesis 1.1b, β = 0.489; p<0.001. For hypothesis 1.2, β = 0.502; p<0.05.

For hypothesis 1.3, bricolage also fully mediated the relationship between knowledge constraints and innovation (χ²(109) =184.203 (p < .001); χ²/df=1.690; CFI = 0.952; IFI = 0.960; TLI = 0.948; RMSEA = 0.051), whereas bricolage partially mediated the relationship between financial constraints and innovation (χ²(108) =174.439 (p < .001); χ²/df=1.614; CFI = 0.941; IFI = 0.957; TLI = 0.960; RMSEA = 0.061).

This series of robustness checks suggested that the results in this paper have a high level of validity.

DISCUSSION
In this paper, I attempted to extend the understanding of bricolage-innovation link by examining the influence of resource constraints on bricolage, which in turn affects innovation and by investigating the different effects of two forms of bricolage on innovation. In particular, I looked at how knowledge constraints and financial constraints influence bricolage as well as innovation. As shown in the results of the data analysis, bricolage fully mediates the relationship between knowledge constraints and innovation. This finding is consistent with prior findings that bricolage positively influences innovation (e.g., Gundry et al., 2011; Salunke et al., 2013; Senyard et al., 2014). This finding also suggests that bricolage is a mechanism through which firms with knowledge constraints achieve their innovation goals. It contributes to the ongoing literature by identifying the mechanism in the relationship between resource constraints and innovation.

This finding confirms the positive link between resource constraints and bricolage.

This is one of the first papers that empirically test the influence of resource constraints on
Previous studies on bricolage assume that resource constraints are triggers of bricolage. However, few of them empirically test the link between these two variables. In this paper I contributed to the existing literature by developing validated measurements for knowledge constraints and financial constraints and empirically assessing the impact of resource constraints on bricolage. The measurements for knowledge constraints and financial constraints could be useful for future research that aims to empirically investigate the influence of resource constraints on other outcome variables.

In the literature, empirical evidence has shown that resources constraints sometimes can promote firm innovation (Gibbert & Scranton, 2009; Katila & Shane, 2005; Keupp & Gassmann, 2013). However, resource constraints are not likely to be a direct predictor of innovation success. Otherwise, firms with fewer resources will always outperform firms with more resources (Gibbert et al., 2014). Therefore, scholars are interested to explore under what conditions or with what innovation strategies resource constraints constitute an enabler of innovation (Gibbert et al., 2014). As earlier stated, the literature linking bricolage and innovation has overlooked the role of resource constraints. On the other hand, the literature connecting resource constraints and innovation have ignored the mechanisms that how resource constraints promote innovation (Keupp & Gassmann, 2013). Therefore, I integrated both streams of literature to understand how resource constraints influence innovation in new firms.

The findings provide a tentative answer to this important question by identifying bricolage as a mechanism that transforms knowledge constraints to innovation.

Knowledge is a key factor for firm innovation (Amabile, 1988; Damanpour, 1991). Therefore, the conventional perspective believes that knowledge constraints will inhibit
innovation, especially when innovation-related knowledge is missing (Carlile, 2004). However, knowledge constraints may trigger entrepreneurial searches for opportunities and generate significant knowledge outcomes because entrepreneurs are likely to recombine existing knowledge in novel ways when facing knowledge constraints (Floyd & Wooldridge, 1999; Zahra, Nielsen, & Bogner, 1999). Knowledge constraints cannot easily be overcome because knowledge is usually highly special and dependent on specific firm routines and prior search paths (Carlile, 2004). In this situation, entrepreneurs may tend to recombine the existing knowledge to achieve the firm goals.

The recombination of knowledge in novel ways is a facilitator of innovation (Fleming & Sorenson, 2004; Majchrzak, Cooper, & Neece, 2004). For instance, Keupp and Gassmann (2013) found a direct link between knowledge constraints and radical innovation. However, the mechanism in that link was not discussed in that paper. The current study took things further, as bricolage was found to act as the mechanism that translates knowledge constraints into innovation outcomes.

The results also showed that bricolage partially mediated the relationship between financial constraints and innovation. This is an interesting finding given the finding that bricolage does fully mediate the relationship between knowledge constraints and firm innovation. It would be interesting to dig why bricolage fully mediates the relationship between knowledge constraints and firm innovation but not the relationship between financial constraints and firm innovation. One possible explanation could be that financial-constrained firms may tend to seek for external resources to support their innovation goals rather than making do by recombining their existing resources. Nowadays, more and more approaches exist for firms to access external funding when
internal capital is insufficient for innovation projects. For example, firms can raise
funding by venturing (Wadhwa & Kotha, 2006), by open innovation (Chesbrough et al.,
2006), or by some newly financial means, such as crowdfunding (Mollick, 2014). With
more and more financial means available, firms with limited financial resources can seek
external funding readily. Therefore, they do not necessarily have to depend on
recombining existing resources.

The partial mediation effect suggests that financial constraints exert a direct effect on
bricolage as well as firm innovation. This finding is consistent with Keupp and Gassmann
(2013), who found a positive effect of financial constraints on innovation. This finding
also confirms the link between financial constraints and bricolage. Firms with financial
constraints are forced to make do with their limited financial resources (Mosakowski,
2002) and are pushed to make novel resource recombinations (Bradley et al., 2011). The
lack of financial resources may lead entrepreneurs to seek creative solutions to an
problem (Gibbert & Scranton, 2009). Therefore, financial constraints can trigger
bricolage behaviors.

A widespread notion is that the access to financial resources is a key determinant of
firm performance (Camisón-Zornoza et al., 2004; Gassmann & Zedtwitz, 2003).
However, research has also suggested that financial constraints may facilitate innovation
(Hoegl et al., 2008; Katila & Shane, 2005). For instance, Katila and Shane (2005)
specified environmental conditions under which new firms (with fewer resources) may
show a higher rate of innovation than established ones (with greater resources) do.
Mishina, Pollock, and Porac (2004) argued that the financial slack may be inefficient and
signal the lack of entrepreneurial spirit in organization. The literature in psychology and
creativity suggested that constraints can trigger creative behaviors, which may bring innovative outcomes (Finke et al., 1992; Moreau & Dahl, 2005; Ward, 2004). For instance, Moreau and Dahl (2005) argued that individuals are more innovative when given fewer rather than more resources for solving an innovation problem. This finding provided empirical evidence to this stream of research that financial constraints could act as the enabler of firm innovation.

**IMPLICATIONS FOR THEORY**

In terms of theory, this paper extends the bricolage-innovation relationship by testing resource constraints as an antecedent of this link. Prior literature assumes resource constraints are triggers of bricolage. This argument lacks empirical test. Therefore we might not have adequate confidence to argue that resource constraints definitely trigger bricolage behaviors. Moreover, there is evidence showing that large companies that are not that resource-constrained also sometimes engage in bricolage (e.g., Halme et al., 2012). Therefore, the empirical test of the relationship between resource constraints and bricolage becomes necessary. The findings of this paper confirm that this relationship does empirically exist. Second, this paper also fills the missing link between resource constraints and innovation. In particular, it found that bricolage fully mediates the relationship between knowledge constraints and firm innovation. This finding helps to resolve, to some extent, the debate whether resource constraints promote innovation (Gibbert et al., 2014). It is not precise to state resource constraints promote or not promote innovation. It is necessary to consider under what conditions or through what actions the resource constraints will exert a positive impact on innovation (Katila & Shane, 2005). In this paper, it is suggested that whether knowledge constraints facilitate innovation partially depends on whether the firms engage in bricolage behaviors.
This paper also contributes to the innovation literature. It helps to answer the question that why new firms with limited resources can sometimes achieve innovation goals (Prusa & Schmitz, 1991). Resource constraints cannot be automatically transformed to innovation outcomes. Some mechanisms are needed in this transformation process. This paper suggests that bricolage could act as one of the mechanisms that help resource-constrained firms to achieve innovation outcomes.

**IMPLICATIONS FOR PRACTICE**

In terms of practical implication, first, this finding offers a pathway for resource-constrained firms to achieve their innovative goals. For many new firms, resource limitation might be a major challenge in the innovation process. For example, they may face knowledge constraints (Katila & Ahuja, 2002; Shane & Cable, 2002). Under this circumstance, firms can consider engaging in bricolage to make do with whatever knowledge resources at hand. For instance, employees in different sectors may consider collaborating and combining their expertise to solve the problems that firms face. Second, the findings suggest that resource constraints can sometimes facilitate innovations. Therefore, firms do not necessarily have to seek external resources in order to achieve innovation goals. Instead, they could allow the existence of certain degree of resource constraints, which may trigger firms to be more creative and innovative.

**LIMITATIONS AND FUTURE RESEARCH**

Some limitations need to be acknowledged when interpreting the results of this study. These limitations may also provide opportunities for future research. First, due to the constraints of cross-sectional data, the results provided no evidence of causality. Future
research can consider conducting longitudinal studies to test the causal relationships between variables in this paper.

Second, the measurement for selective bricolage and parallel bricolage does not have satisfactory validity. This caused the failure of examining the influence of parallel bricolage and selective bricolage on innovation. Future studies may want to develop validated measurements for these two variables in order to unravel how parallel bricolage and selective bricolage affect innovation or any other variables. One possible direction is to look at the domains of the bricolage behaviors. As Baker & Nelson (2005) suggest, bricoleurs engage in bricolage behaviors in five domains. More (less) domains that bricoleurs engage in bricolage behaviors may be regarded as indicator of parallel bricolage (selective bricolage).

Third, a single informant, i.e., a business owner or manager, completed the survey. This could have resulted in common method bias. I took actions, such as assuring the respondents of their confidentiality, to minimize this issue (Tang et al., 2015). I also ran the one-factor analysis (Harman, 1976) to detect this issue. The results suggest that common method bias is not a problem in this study. Despite this, future studies may need to consider collecting data from different sources to minimize the potential bias resulting from single informant. For example, the owner of the business can answer questions related with the whole company. Other informants, such as the product manager, can answer questions associated with innovations.

Some other possible future directions scholars may consider are described as follows. First, two forms of resource constraints are examined in this paper. The full as well as partial mediation role of bricolage implies that firms may take different actions when
they face different types of resources constraints. Different types of resources constraints might have different influences on firm outcomes. Therefore, future research may need to break down resource constraints into several sub factors when investigating the influence of resource constraints on firm outcomes. Besides knowledge constraints and financial constraints discussed in this paper, there might be some other types of resource constraints that are worthwhile to explore. For example, how the constraints of human capital or social capital will influence innovation outcomes? Both human and social capital is crucial for firm innovation (Dakhli & De Clercq, 2004). Therefore, the lack of both capitals may exert an impact on innovation. Second, future research may consider the contingent effect in the relationships of this paper. For example, the influence of resource constraints on bricolage might be enhanced or attenuated by industry type, the development stage of a firm, or the individual factors of entrepreneurs. For instance, bricolage is a behavior that individuals, such as firms’ owners, CEOs, or managers, execute (Baker & Nelson, 2005). Therefore, individual-level factors are important for understanding why entrepreneurs engage in bricolage behaviors.

**CONCLUSION**

Based on the literature of resource constraints, bricolage, and innovation, this paper attempted to enrich the relationship between bricolage and innovation by adding resource constraints as an antecedent of this link and by assessing the effects of selective bricolage and parallel bricolage on innovation. As shown in the results, I found that bricolage fully mediates the relationship between knowledge constraints and innovation, whereas it has a partial mediation role in the relationship between financial constraints and innovation. This finding contributes to the literature by identifying the mechanism through which knowledge-constrained firms achieve innovation goals. It also extends the bricolage-
innovation link by identifying knowledge constraints as an antecedent. Unfortunately I failed to measure parallel bricolage and selective bricolage, thus not being able to examine the effects of both forms of bricolage on innovation. I encourage future research to develop validated measurements for these two variables.

As discussed earlier, although the consequences of bricolage have been extensively examined, relatively little research has investigated how bricolage might influence entrepreneurial orientation (EO), an important firm-level outcome variable. Given that theoretical linkages exist between bricolage and EO, the goal of next essay was to investigate how bricolage might influence EO.
INTRODUCTION
Entrepreneurial orientation (EO) has long been considered a facilitator of firm performance (e.g., Anderson & Eshima, 2013; Barringer & Bluedorn, 1999; Covin & Lumpkin, 2011; Covin & Miller, 2014; Rauch et al., 2009; Wang & Juan, 2015). EO firms tend to identify new opportunities with potentially large returns, innovate frequently, and obtain first-mover advantage (Lumpkin & Dess, 1996; Miller & Friesen, 1982). These attributes are likely to bring about better firm performance in today’s business environments where the external environment of the firm is fast-changing and where firms need to constantly seek out new opportunities for coping with the uncertainty (Hamel & Ruben, 2000; Wiklund & Shepherd, 2005). Indeed, EO has been found to positively influence various firm outcomes such as sales growth rate (Covin, Green, & Slevin, 2006), firm profitability (Baker & Sinkula, 2009), firm growth (Anderson & Eshima, 2013), new venture performance (Stam & Elfring, 2008), product innovation (Tang et al., 2015), etc. By analyzing fifty one scholarly articles about the EO-performance link in a meta-analysis, Rauch et al. (2009) conclude that the effects of EO on firm performance are moderately large.

Though the outcomes of EO have been widely examined, the factors that predict EO remain poorly understood, especially in the resource-constrained environment. In fact, many entrepreneurial firms are constrained by their limited resources (Garud & Karrøe, 2003; Salunke et al., 2013). Initiatives in entrepreneurial firms are often carried out under condition of inadequate resources (Sirmon, Hitt, & Ireland, 2007). To achieve their goals,
entrepreneurial firms tend to conquer the resource constraints through new combination of organization resources (Alvarez & Busenitz, 2001; Dess et al., 1999). They are likely to pursue opportunities by reconfiguring their existing resources and combining resources with complementary assets (Wu, 2007). Alvarez and Busenitz (2001) argued that entrepreneurial firms have a central capability to recognize opportunities and efficiently reorganize resources to generate heterogeneous outputs. This capability of entrepreneurial firms closely corresponds with the key feature of bricolage: making do by applying combinations of the resources at hand (Baker & Nelson, 2005). In other words, both bricolage and EO inherently involve with recombining existing resources. As such, one question that is interesting to ask would be: Does engaging in bricolage behaviors make a firm more entrepreneurial oriented?

Miller (1983: 771) argued that “an entrepreneurial firm is one that engages in product-market innovation, undertakes somewhat risky ventures and is first to come up with ‘proactive’ innovations, beating competitors to the punch”. EO was later developed by Covin and Slevin (1989) and was defined as the processes, structures, and behaviors of firms that are characterized by innovativeness, proactiveness, and risk-taking. Bricolage is expected to be related to EO because bricolage might influence each dimension of EO.

First, bricolage may sometimes bring innovation outcomes (Baker & Nelson, 2005; Salunke et al., 2013; Senyard et al., 2014). Therefore, engaging in bricolage behaviors might drive firm’s innovativeness posture, which enables firms to pursue their innovation goals. In addition, bricolage may create an environment that encourages firms to pursue their innovation goals despite how much resources they have (Senyard et al., 2014). Such an environment is likely to cultivate innovativeness posture because innovativeness
oriented firms are committed to generate new products and services regardless of their limited resources (Lumpkin & Dess, 1996). Second, bricoleurs choose refusal to enact limitations on existing resources (Phillips & Tracey, 2007) by proactively recombining their existing resources at hand. This feature of bricolage corresponds with that of proactiveness, through which firms proactively seek and reorganize resources (Lumpkin & Dess, 1996). Therefore, bricolage might create an environment that triggers proactiveness posture of a firm. In addition, making do with resources at hand might be an effective way for firms to cope with opportunities and challenges more quickly than their competitors compared with seeking external resources, which may generate information asymmetry problem (Holmstrom, 1989). Therefore, engaging in bricolage may support firm’s proactiveness posture and enable a firm to respond quickly to opportunities than their competitors. Finally, bricolage might play a role in influencing risk-taking because making do with existing resources (bricolage) may involve risks (Baker & Nelson, 2005). However, compared with seeking external resources or doing nothing, bricolage may involve different levels of risks (Shan, Song, & Ju, 2016). Therefore, bricolage behaviors may predict the level of risk-taking in a firm. Taken together, bricolage might act as a predictor of EO.

Though a theoretical linkage between bricolage behaviors and EO could be expected, it is surprising that few studies have examined the potential relationships between them. This essay seeks to fill this gap by examining the effect of bricolage on EO. Given that EO is a multi-dimensional variable (e.g., Dai et al., 2014; Kreiser et al., 2002; Rauch et al., 2009), I explored the relationship between bricolage behaviors and the three
dimensions of EO (innovativeness, proactiveness, and risk-taking) respectively. Please see Figure 4 for the conceptual model of this paper.

The intent of this study was to offer the following contributions to theory and practice. First, I hope to make a contribution to bricolage theory as well as EO literature by investigating whether bricolage acts as an essential predictor of EO. As EO has long been considered as a facilitator of better firm performance (e.g., Anderson & Eshima, 2013; Barringer & Bluedorn, 1999; Covin & Lumpkin, 2011; Covin & Miller, 2014; Rauch et al., 2009; Wang & Juan, 2015), it is theoretically important to look at the origins of EO. Furthermore, the literature suggests that bricolage might predict EO. Therefore, it is meaningful to examine how bricolage may affect EO. This can help with enhancing our scholarly understanding on the outcomes of bricolage. It also sheds light on what factors drive EO in the context of resource constraints. Second, this study also hopes to contribute to the practice by identifying the possible influence of bricolage on each dimension of EO. Therefore, entrepreneurs may learn how to facilitate EO by engaging in bricolage behaviors in the context of resource constraints.

**THEORY AND HYPOTHESES**

**Key Constructs**

*Entrepreneurial orientation and its dimensions*

Miller (1983) first conceptualized EO, and it has become a main construct in the strategic management and entrepreneurship literature over the years (Morris, Kuratko, & Covin, 2010). In his seminal paper, Miller argued that “an entrepreneurial firm is one that engages in product-market innovation, undertakes somewhat risky ventures and is first to come up with ‘proactive’ innovations, beating competitors to the punch” (1983: 771).
Covin and Slevin (1989) defined EO as the processes, structures, and behaviors of firms that are characterized by innovativeness, proactiveness, and risk-taking. Innovativeness refers to the willingness and capability of the firm to embrace and to engage in new ideas, novelty, experimentation, and creative processes (Lumpkin & Dess, 1996). Proactiveness is defined as the posture of anticipating and acting on future needs and trends, thereby creating first-mover advantages over competitors (Lumpkin & Dess, 1996). Risk-taking refers to a company’s proclivity for risk projects with chances of high returns or high losses and implies a willingness to act boldly even without knowing all potential consequences (Wilklund & Shepherd, 2003).

EO firms tend to identify new opportunities with potentially large returns, innovate frequently, and obtain first-mover advantage (Lumpkin & Dess, 1996; Miller & Friesen, 1982). These attributes are likely to bring about better firm performance in today’s business environments where the external environment of the firm is fast-changing and where firms need to constantly seek out new opportunities for coping with the uncertainty (Hamel & Ruben, 2000; Wiklund & Shepherd, 2005). Previous literature suggests that each of the sub dimensions of EO can positively influence firm performance. For instance, innovative companies are likely to enjoy extraordinary economic performance by generating new products, services, and technologies to the market (Brown & Eisenhardt, 1998). Proactive companies can obtain the first-mover advantage, which enables them to target profitable market segments and charge high prices, thus improving their firm performance (Zahra & Covin, 1995). The relationship between risk-taking and performance is less evident. However, research suggests that risky strategies may be
more profitable in the long term because some projects can succeed while others fail (March, 1991; McGrath, 1999).

Therefore, EO has long been considered a facilitator of better firm performance (e.g., Anderson & Eshima, 2013; Barringer & Bluedorn, 1999; Covin & Lumpkin, 2011; Covin & Miller, 2014; Rauch et al., 2009; Wang & Juan, 2015). For example, Covin et al. (2006) found that EO has a positive impact on sales growth rate. Baker and Sinkula (2009) evidenced that EO plays important role in firm’s profitability. Anderson and Eshima (2013) demonstrated a positive link between EO and firm growth. Stam and Elfring (2008) found a positive link between EO and new venture performance. By analyzing 51 scholarly articles about the EO-performance link in a meta-analysis, Rauch et al. (2009) conclude that the effects of EO on performance are moderately large. Besides performance, EO has also been argued to influence other types of outcomes, such as the international scope (Dai et al., 2014) and strategic alliance (Marino, Strandholm, Steensma, & Weaver, 2002).

Although the positive impact of EO on firm performance has been found in many studies, some studies did not find a significant EO-performance relationship (Covin, Slevin, & Schultz, 1994; George, Robley Wood Jr, & Khan, 2001). This suggests that some variables mediate or moderate the EO-performance relationship (Messersmith & Wales, 2013; Rauch et al., 2009). Extensive research has explored the possible moderators in the relationship between EO and outcome variables. For instance, Stam and Elfring (2008) found that the combination of high network centrality and extensive bridging ties strengthened the positive link of EO and new venture performance. Messersmith and Wales (2013) demonstrated that firms combining high performance
work systems or partnership philosophy with EO realized significantly higher levels of growth. Wiklund and Shepherd (2005) evidenced that small business performance is highest among firms with a high degree of EO, greater access to financial capital, and in dynamic environments. De Clercq et al. (2010) found that the EO-performance link is stronger for higher levels of procedural justice, trust, and organizational commitment. Although the research on the moderators in EO performance has been extensively studied, research on mediators is still very limited (Wales, Gupta, & Mousa, 2013). As Wales, Gupta, et al. (2013) stated, there is ‘little understanding of the causal mechanisms of how or why EO affects other variables’.

Similarly, the origins of EO have also remained limited understanding. An exception is that EO has been argued to relate with entrepreneurial behaviors (Kollmann & Stöckmann, 2014). As Rauch et al. (2009) put it, EO is the policies and practices that provide a basis for entrepreneurial decisions and actions. Similarly, Wiklund (1998) treated EO as the willingness of a firm to engage in entrepreneurial behavior. These views suggest the possibility that EO might be associated with behaviors in the firm.

Indeed, the literature has provided some evidence indicating that EO is associated with behaviors of recombining existing resources to solve problems and pursue opportunities. Dess et al. (1999), for example, argued that EO is a key strategy of organizational transformation through the new combination of organization resources. Likewise, Alvarez and Busenitz (2001) stated that entrepreneurial oriented firms have a central capability to recognize opportunities and efficiently reorganize resources to generate heterogeneous outputs. EO firms are likely to pursue opportunities by reconfiguring their existing resources and combining resources with complementary assets (Wu, 2007).
Furthermore, Lumpkin and Dess (2001) demonstrated that a firm with high EO will be more willing to deploy resources to support risky and proactive endeavors. These referred studies suggest that EO might be related with behaviors of recombining existing resources.

It is worthwhile to mention that some debates have taken place about the dimensionality of EO in the literature. Some scholars treat EO as a unidimensional construct and the sub-dimensions of EO are aggregated together when measuring EO (Covin & Slevin, 1989; Hughes & Morgan, 2007; Knight, 1997). However, some other scholars suggest that EO is a multidimensional construct. The different dimensions of EO represent a different and independent aspect of EO and may offer unique contributions to outcome variables (Covin et al., 2006; Kreiser et al., 2002; Lumpkin & Dess, 2001; Rauch et al., 2009). For example, Marino et al. (2002) found evidence to support this argument by finding that the three dimensions of EO have low correlations and significant individual variable variance. Likewise, Lumpkin and Dess (2001) argued that proactiveness and competitive aggressiveness are differentially related to performance. Moreover, some recent works treated EO as a multidimensional construct and found different effects of the sub-dimensions of EO on the outcome variables (e.g., Dai et al., 2014; Kreiser, Marino, Kuratko, & Weaver, 2013; Lomberg, Urbig, Stöckmann, Marino, & Dickson, 2016). Dai et al. (2014), for instance, found innovativeness, proactiveness, and risk-taking exert different effects on international scope. Kreiser et al. (2013) demonstrated that innovativeness and proactiveness displayed predominantly positive U-shaped relationships with SME performance. Risk-taking, however, displayed a predominantly negative U-shaped relationship with SME performance. Indeed, a meta-
analysis of EO that Rauch et al. (2009) conducted suggested that studying the antecedents and outcomes of EO from the perspective of sub-dimensions might be more appropriate. The current essay followed this lead and treated EO as a multidimensional construct.

**Entrepreneurial bricolage**

As earlier discussed, bricolage was originally introduced by Levi-Strauss (1966), who considered bricolage to be the process that people use to combine the various resources they have at hand as a means of finding workable approaches to problems and opportunities. It focuses on addressing opportunities and problems with existing undervalued or discarded resources that are often available for free or cheaply (Desa & Basu, 2013). In the entrepreneurship literature, bricolage is defined as making do by applying combinations of the resources at hand to new problems and opportunities (Baker & Nelson, 2005). In other words, bricolage is a form of resourcefulness by means of recombining resources for novel purposes (Senyard et al., 2014). Bricoleurs innovate, adapt, and recombine existing or available resources in the organization, such as human capital and materials, to new problems and opportunities. Specifically, entrepreneurs enact bricolage in domains including physical inputs, labor inputs, skill inputs, customers/markets, and institutional and regulatory environment, refusing to enact limitations with regard to many “standards” and regulations (Baker & Nelson, 2005; Fisher, 2012).

The outcomes of bricolage have been widely investigated in the literature (e.g., Garud & Karnøe, 2003; Halme et al., 2012; Senyard et al., 2014; Senyard et al., 2010; Stenholm & Renko, 2016). For example, bricolage has been found to have positive impact on firm
growth (Baker & Nelson, 2005), firm sales (Senyard et al., 2010), innovativeness of new firms (Senyard et al., 2014), supportive innovation performance (Salunke et al., 2013), entrepreneur’s catalytic innovation (Gundry et al., 2011), venture survival (Stenholm & Renko, 2016), opportunity identification (An, Zhao, Cao, Zhang, & Liu, 2017), etc. The referred studies above, among others, signify the important role that bricolage plays in the performance-related variables of firms that face resource constraints.

Although the outcomes of bricolage have been extensively examined, relatively little research has investigated how bricolage might influence entrepreneurial orientation (EO), an important firm-level variable. One exception comes from Peltonen and Arenius (2011). They proposed that the sub-dimensions of EO can be linked to bricolage. In particular, they found positive and significant relationships between bricolage and proactiveness, autonomy, and innovativeness dimensions of EO, but nonsignificant relationships between bricolage and competitive aggressiveness and risk-taking. Although they tried to link EO and bricolage, they did not articulate a causal relationship.

The literature suggests that bricolage may act as a predictor of EO. Bricolage has been found to exert positive influence on innovation (Baker & Nelson, 2005; Salunke et al., 2013; Senyard et al., 2014). In addition, bricoleurs tend to proactively recombine their existing resources at hand (Phillips & Tracey, 2007). Further, bricolage also involves with risks (Baker & Nelson, 2005). These features of bricolage might be related with the sub dimensions of EO, namely innovativeness, proactiveness, and risk taking.

**Summary of literature on EO and bricolage**

Tables 2.1 and 2.2 listed the EO and bricolage literature that is relevant with this study. The literature review of EO suggests that EO could be associated with behaviors of
recombining existing resources. By definition, bricolage is a behavior of making do by applying combinations of existing resources at hand. As said, EO is considered to be associated with entrepreneurial behavior (Kollmann & Stöckmann, 2014; Wiklund, 1998). It denotes the policies and practices that provide a basis for entrepreneurial decisions and actions (Rauch et al., 2009). Additionally, the literature has provided some evidence indicating that EO is associated with behaviors of recombining existing resources to solve problems and pursue opportunities. For example, EO is considered a key strategy of organizational transformation through the new combination of organization resources (Dess et al., 1999). EO firms are likely to pursue opportunities by reconfiguring their existing resource and combining resources with complementary assets (Wu, 2007).

Furthermore, Alvarez and Busenitz (2001) argued that entrepreneurial oriented firms have a central capability to recognize opportunities and efficiently reorganize resources to generate heterogeneous outputs. As said, bricolage is a form of entrepreneurial behavior aiming to solve problems by recombining existing resources at hand (Baker & Nelson, 2005). Further, EO is related to goal-seeking behaviors to translate such a strategic posture to the actual performance (Lumpkin & Dess, 1996). Many new firms, however, either lack adequate resources or lack the desire or ability to seek external resources. Thus, engaging in bricolage provides an alternative avenue of goal-seeking behavior for firms with EO. Based on this line of reasoning, I expect that bricolage may act as a driver of EO, which in turn affects outcomes of the firm.
Table 2.1: Selected Works for EO

<table>
<thead>
<tr>
<th>Author name</th>
<th>Dependent variables</th>
<th>Sample</th>
<th>Key findings (arguments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JG Covin, KM Green, and DO Slevin (2008)</td>
<td>sales growth</td>
<td>110 manufacturing firms</td>
<td>EO is positively related to sales growth rate</td>
</tr>
<tr>
<td>WE Baker and XM Shih (2009)</td>
<td>profitability</td>
<td>100 small firms</td>
<td>EO has an indirect positive impact on profitability through innovation success</td>
</tr>
<tr>
<td>BS Anderson and Y Ekholm (2012)</td>
<td>firm growth</td>
<td>207 SMEs</td>
<td>EO and firm growth relationship is strengthened in young firms and firms with more intangible resources</td>
</tr>
<tr>
<td>Messerlin and Wales (2013)</td>
<td>sales growth</td>
<td>119 young high-tech firms</td>
<td>Firms combining high performance work systems or partnership philosophy with EO realized significantly higher levels of growth</td>
</tr>
<tr>
<td>CL Wang (2008)</td>
<td>firm performance</td>
<td>213 medium to large firms</td>
<td>Learning orientation mediates the EO-performance relationship</td>
</tr>
<tr>
<td>Johan Widlund and D. Shepherd (2005)</td>
<td>firm performance</td>
<td>405 small business</td>
<td>Small business performance is highest among firms with a high degree of EO, greater access to financial capital, and in dynamic environments</td>
</tr>
<tr>
<td>L. Dai, VMakridou, BA Gilson, and SA Femister (2014)</td>
<td>international scope</td>
<td>500 SMEs</td>
<td>The relationship between firm international scope and innovativeness is U-shaped. The relationship between international scope and firm innovativeness is U-shaped.</td>
</tr>
<tr>
<td>Marzo et al. (2002)</td>
<td>strategic alliance</td>
<td>SMEs in a larger survey</td>
<td>Higher levels of entrepreneurial orientation will use strategic alliances more extensively</td>
</tr>
<tr>
<td>D DeCleir, D Den, and NI Thongphail (2010)</td>
<td>firm performance</td>
<td>232 Canadian-based firms</td>
<td>The EO-performance link is stronger for higher levels of procedural justice, trust, and organizational commitment</td>
</tr>
<tr>
<td>Zahra and Covin (1995)</td>
<td>financial performance</td>
<td>100 firms</td>
<td>Proactive companies can obtain the firm's advantage by improving their firm performance</td>
</tr>
<tr>
<td>Peltonen and Arenius (2011)</td>
<td>EO</td>
<td>119 Finnish software companies</td>
<td>These are positive and significant relationships between bricolage and proactiveness, autonomy, and innovativeness dimensions of EO</td>
</tr>
<tr>
<td>Luompani and Dent (2001)</td>
<td>firm performance</td>
<td>124 executives from 94 firms</td>
<td>Proactiveness and competitive aggressiveness had different impacts on firm performance in different industry life cycle and external environment</td>
</tr>
<tr>
<td>Loose, Ullig, Goldsmann, Marzo, &amp; Dizdare (2016)</td>
<td>firm performance</td>
<td>high tech and low tech firm</td>
<td>Innovativeness, proactiveness, and risk taking exert unique effects on firm performance</td>
</tr>
</tbody>
</table>

Research about the relationship between bricolage and EO is little. One exception comes from Peltonen and Arenius (2011). They proposed that the sub-dimensions of EO can be linked to bricolage. In particular, they found positive and significant relationships
between bricolage and proactiveness, autonomy, and innovativeness dimensions of EO, but nonsignificant relationships between bricolage and competitive aggressiveness and risk-taking. Although they tried to link EO and bricolage, they did not articulate a causal relationship. On the contrary, in my paper, I will provide theoretical argumentation for a casual direction from bricolage to EO.

The literature review suggests that some debates about the dimensionality of EO are still taking place. Some scholars treat EO as a unidimensional construct and the three dimensions of EO are aggregated together when measuring EO (Covin & Slevin, 1989; Hughes & Morgan, 2007; Knight, 1997). However, more recent theorizing suggests that EO is a multidimensional construct (Covin et al., 2006; Kreiser et al., 2002; Lumpkin & Dess, 2001; Rauch et al., 2009). A meta-analysis of EO by Rauch et al. (2009) suggested that studying the antecedents and outcomes of EO from the perspective of sub-dimensions might be more appropriate. Researchers in some recent works treated EO as a multidimensional construct and found different effects of the sub-dimensions of EO on the outcome variables (e.g., Dai et al., 2014; Kreiser et al., 2013; Lomberg et al., 2016).

Following this stream of research, in this paper, I will discuss how bricolage influences the three dimensions of EO (innovativeness, proactiveness, and risk-taking) respectively.
Table 2.2: Selected Works for Bricolage

<table>
<thead>
<tr>
<th>Author(s) &amp; Year</th>
<th>Dependent variables</th>
<th>Sample</th>
<th>Key findings (arguments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baks and Nalton (2005)</td>
<td>firm growth</td>
<td>20 resource-constrained firms</td>
<td>Companies engaging in bricolage refuse to accept the limitations imposed by dominant definitions of resource environments</td>
</tr>
<tr>
<td>Seryd et al. (2010)</td>
<td>firm performance</td>
<td>1011 young firms</td>
<td>Bricolage has a significant positive relationship to sales</td>
</tr>
<tr>
<td>Seryd et al. (2014)</td>
<td>innovativeness</td>
<td>1185 young firms</td>
<td>There is a positive relationship between bricolage and innovativeness of new firms</td>
</tr>
<tr>
<td>Salunkhe et al. (2013)</td>
<td>supportive innovation performance</td>
<td>453 US and Australia firms</td>
<td>Bricolage indirectly relates to competitive advantage through service innovation</td>
</tr>
<tr>
<td>Gundry et al. (2011)</td>
<td>catalytic innovation</td>
<td>113 social entrepreneurs</td>
<td>Bricolage facilitates social entrepreneur’s catalytic innovation</td>
</tr>
<tr>
<td>Desa (2012)</td>
<td>use of bricolage</td>
<td>202 technology firms</td>
<td>Social enterprises confronted by weak or emergent regulative institutions are more likely to engage in bricolage</td>
</tr>
<tr>
<td>Steinholt and Ranko (2016)</td>
<td>new venture survival</td>
<td>2489 Finnish entrepreneurs</td>
<td>Bricolage is positively related to new venture survival</td>
</tr>
<tr>
<td>An et al. (2017)</td>
<td>corporate entrepreneurship</td>
<td>248 incumbent firms</td>
<td>Opportunity identification mediates the relationship between bricolage and corporate entrepreneurship</td>
</tr>
<tr>
<td>Wiess et al. (2017)</td>
<td>service innovation</td>
<td>five organizations</td>
<td>Capabilities for making do with what organizations have at hand are positively associated with service innovation outcomes</td>
</tr>
<tr>
<td>Desa and Basu (2013)</td>
<td>bricolage</td>
<td>202 technology-social ventures</td>
<td>Ventures are more likely to use bricolage under conditions of low organizational prominence or external munificence</td>
</tr>
<tr>
<td>Essin (2009)</td>
<td>service innovation</td>
<td>case study Swedish</td>
<td>Individual’s “making do with resources at hand” can trigger service innovation</td>
</tr>
<tr>
<td>Halme, et al. (2012)</td>
<td>innovation of MNCs</td>
<td>two cases</td>
<td>Interpersonal bricolage is of fundamental importance in MNC innovation for ex ante business</td>
</tr>
<tr>
<td>Burg et al. (2012)</td>
<td>opportunities identification</td>
<td>219 SMEs</td>
<td>Resource constraints direct the entrepreneur’s attention toward opportunities inside the constrained domain rather than outside the constrained domain</td>
</tr>
<tr>
<td>Sundaramurthy et al. (2016)</td>
<td>bricolage</td>
<td>30 cases</td>
<td>Successful social entrepreneurs engage in similar bricolage processes in three domains of value creation: they tend to escape limitations imposed by the environment, utilize resources in new and innovative ways, and engage a wide range of stakeholders as partners.</td>
</tr>
</tbody>
</table>

Hypotheses Development

In this section, I will develop hypotheses that relate bricolage to the three dimensions of EO (innovativeness, proactiveness, and risk-taking).
**Bricolage and innovativeness**

Innovativeness refers to the willingness and capability of the firm to embrace and to engage in new ideas, novelty, experimentation, and creative processes (Lumpkin & Dess, 1996). It orientates the firm toward embracing experimentation to generate novel products, services, and processes (Miller, 1984). Bricolage behaviors may drive innovativeness orientation due to the following rationales.

First, bricolage can sometimes lead to innovation (Baker & Nelson, 2005; Katila & Shane, 2005; Senyard et al., 2014); thus, by engaging in bricolage, firms may be able to drive their innovativeness postures to generate innovation outcomes. Bricolage is a process of creatively recombining resources. As suggested by theory of recombinative innovation, resource recombination may generate innovative outcomes (Henderson & Clark, 1990; Keupp & Gassmann, 2013; Nelson & Winter, 2009). As Levi-Strauss (1966) pointed out, the novel combinations of nonstandard resources can sometimes generate brilliant unforeseen outcomes, such as innovations. In addition, firms engaging in bricolage behaviors can create heterogeneous value from resources available cheaply or for free (Baker & Nelson, 2005). As Penrose (1995) stated, firms can provide different services to the market when they operate highly similar material and human resource inputs because they have different abilities to find possible uses and combinations of those inputs. Therefore, new firms that do more bricolage may generate more innovations than new firms that do less bricolage because bricolage allows the former to make creative use of limited resources to generate values from the identical resources.

Furthermore, bricoleur-entrepreneurs always try to find solutions for addressing challenges despite resource limitations (Stenholm & Renko, 2016). Compared with the firms that decline to pursue innovation goals due to limited resources, firms engaging in
bricolage have more possibilities to generate innovative outcomes because they choose to overcome resource constraints that would otherwise prevent them from developing innovative solutions (Gundry et al., 2011). Given the potential link between bricolage and innovation, engaging in bricolage may contribute to innovativeness.

Second, translation from innovativeness to performance requires the production of new products, services, and processes, a procedure that involves resources commitment internally and/or externally (Damanpour, 1991). Many new firms face severe resource constraints (Shepherd et al., 2000). Under this circumstance, some new firms may choose to give up pursuing innovation goals. Yet, innovativeness oriented firms are unlikely to stop pursuing opportunities even facing resource constraints because they are committed to generate new products and services despite how much resources they have (Lumpkin & Dess, 1996). This feature of innovativeness orientation corresponds closely with that of bricolage, which directs entrepreneurs make do with existing resources regardless resource limitation (Baker & Nelson, 2005).

As a response to the adversity environment, innovativeness oriented firms may choose to seek external resources. However, in many cases, it is difficult for new firms to acquire outside resources due to information asymmetry problems (Holmstrom, 1989). Thus, many new firms have to depend on the very limited resources existing in the firms (Cassar, 2004; Teece, 1986) and make do with the resources at hand to problems and opportunities (Baker & Nelson, 2005). Bricolage enables new firms to pursue their innovative goals regardless of how much resources they have by recombining existing resources at hand in novel ways, thus preventing resource scarcity from dragging down new firms (Senyard et al., 2014). Therefore, bricolage may create an environment that
drives the innovativeness orientation for resource-constrained firms to increase the chances of generating innovations. Taken together, in this study, I expected that bricolage behavior will facilitate innovativeness orientation in new firms.

Based on this reasoning, I hypothesized that:

Hypothesis 2.1: Bricolage is positively related to innovativeness of new firms.

Bricolage and proactiveness

Proactiveness refers to the posture of anticipating and acting on future needs and trends, thereby creating first-mover advantages over competitors (Lumpkin & Dess, 1996). It represents an opportunity-seeking and forward-looking perspective that provides the firm an advantage over competitors’ actions by anticipating future market demands. Proactiveness enables firms to act in anticipation of future opportunities and emphasizes initiating activities (Lumpkin & Dess, 1996). The reasoning that bricolage might be positively related to proactiveness is discussed as follows.

First, bricoleurs have a bias for action in a way that they choose refusal to enact limitations on existing resources (Phillips & Tracey, 2007). This feature of bricolage corresponds with that of proactiveness, which enables firms to proactively seek and organize resources (Lumpkin & Dess, 1996). Unlike the less proactive firms that are indifferent about or unable to seize opportunities in the market, proactive firms are likely to actively discover resources and opportunities in their internal and external environments (Covin & Lumpkin, 2011; Stevenson & Jarillo, 2007). They choose to
pursue future needs and opportunities regardless how much resources they have.

Bricoleurs make do by actively recombining their existing resources to problems or opportunities. By engaging in bricolage, firms tend to be proactive to make do with their existing resources for intended goals (Baker & Nelson, 2005). Therefore, bricolage may create an environment that supports proactiveness of a firm.

Second, bricolage may enable firms to be more proactive by allowing them to consider alternative uses for resources at hand. Being proactive means that firms need to anticipate and predict new uses for existing resources (Rauch et al., 2009). To obtain or sustain the favorable position in the market, proactive firms should play an initial role in identifying and using their existing resources in creative ways (Covin et al., 2006). By using the resources that their competitors consider to be useless, and by creatively recombining these resources, firms may create unique values from the existing resources and get ahead of their competitors (Rauch et al., 2009). Bricolage creates an environment that encourages firms to explore new uses of existing resources (Baker & Nelson, 2005). By engaging in bricolage behaviors, bricoleurs tend to find novel uses for which the resources were not originally designed, thus making a firm more proactive.

Third, by introducing new products and brands ahead of competitors, proactiveness emphasizes the importance of speed (Shan et al., 2016). Bricolage might be an effective way for firms to cope with opportunities and challenges more quickly than their competitors can. When facing opportunities and challenges, proactive firms tend to give fast responses than their counterparts (Covin & Lumpkin, 2011). Although seeking external resources is an option for resolving challenges or pursuing opportunities, this may take longer than just directly making do with resources at hand. Seeking external
resources poses the information asymmetry problem, which may delay the process of acquiring resources (Holmstrom, 1989). Therefore, depending heavily on the external resources might make firms lose the best time window for addressing opportunities or challenges. Compared with seeking external resources, engagement in bricolage might enable firms to respond more quickly to opportunities or challenges because bricoleurs make do with the resources at hand. Therefore, engagement in bricolage behaviors is expected to enable firms to react to the market more quickly, thus enhancing the level of proactiveness.

Taken together, I hypothesized that:

Hypothesis 2.2: Bricolage is positively related to proactiveness of new firms.

**Bricolage and risk-taking**

Risk-taking refers to a company’s proclivity for risk projects with chances of high returns or high losses and implies a willingness to act boldly even without knowing all potential consequences (Wilklund & Shepherd, 2003). Unlike innovativeness and proactiveness, I expect that engaging in bricolage behaviors is unlikely to cultivate a risk-taking orientation.
First, making do with existing resources at hand might not correspond with the feature of risk-taking firms, which tend to seek external resources. Risk-taking is associated with the tendency to undertake costly diversification into new products or services (Sapienza, De Clercq, & Sandberg, 2005). This may result in increasing investments and lead firms to over-commit resources. To pursue risky goals, risk-taking firms would have to seek external resources, such as investments, because resources at hand may not be sufficient for firms to pursue their risky goals. Some empirical evidence in the literature shows that risk-taking firms tend to engage in behaviors such as making large resource commitments or accruing heavy debt from outside (Shan et al., 2016). For example, high-technology projects are usually at high risk and inevitably needs external support, such as professional venture capital. By engaging in bricolage behaviors, firms tend to exploiting existing resources at hand. Therefore, firms engaging bricolage might not be likely to pursue risky goals, which are involved with seeking external resources.

Second, bricolage is an inherently low-risk behavior compared with seeking external resource. Even though bricolage is not without risks (Baker & Nelson, 2005), seeking external resources to explore risk opportunities might be riskier than bricolage. The worst result of engaging in bricolage might be that firms do not realize their intended goals in recombining existing resources. However, if firms fail in projects associated with substantial external support, such as bank loans, they will probably experience significant loss. Inherently, risk-taking firms may be more likely to engage in some riskier actions such as borrowing external funding instead of exploiting internal resources. Therefore, engaging in bricolage does not reflect a firm’s willingness to engage in risk-taking activities. Based on this reasoning, I expect that:
Hypothesis 2.3: Bricolage is negatively related to risk-taking of new firms.

Figure 4: Conceptual Model of Essay 2

METHOD

Sample and Procedure

As stated in the first essay, one criterion to select sample firms is that the firms should be in the resource constrained context. Therefore, in this study I also collected data from new firms, which are usually confronted with resource scarcity (Shepherd et al., 2000). New firms are defined as firms of eight years of age or younger (Atuahene-Gima & Li, 2004). The data for this essay was collected along with the data in the first essay. It was also collected from ReferenceUSA, which includes verified and accurate information of more than 14 million U.S firms (Baron & Tang, 2011; Kalleberg et al., 1990). For detailed sample procedure, please see the method section in essay one. In the end, I got
198 responses (19.8% response rate), including 161 early responses and 37 late responses. After withdrawing 15 incomplete responses, there were 183 usable responses.

The non-response bias was assessed by comparing the early and late respondents on the mean values of study variables and by comparing the mean responses of respondents and non-respondents on firm age, firm size, and sales revenues (Armstrong & Overton, 1977). The results suggest that there is no non-response bias. I also ran a paired comparison to test if there are significant differences in firm age, size, or sales revenues between firms that agreed to participate in this study and those that did not. The results show that there are no significant differences in firm age, size, or sales revenues (t=0.47 for age; t=0.62 for size; t=0.43 for sales revenue, not significant) between firms that agreed to participate in this study and those that did not, further validating there is no non-response bias in this study.

**Measurement**

Measurements were adapted from the extant literature. In order to enhance the face and content validity of the measures, I conducted pilot study by interviewing several Ph.D. students who are majored in entrepreneurship and surveyed 27 entrepreneurs before sending out the surveys. More information about the pilot study will be displayed below. 5 Likert scale were used for the measurements of the constructs. Respondents were asked to rate their agreement for each statement from one (totally disagree) to five (totally agree). Please see appendix for the measurement items for each construct.
**Dependent variable**

Sub-dimensions of entrepreneurial orientation

The three dimensions of entrepreneurial orientation were measured by using the nine-item scale developed by Covin and Slevin (1989). Each variable was measured by three items. These measurement scale have been widely used and validated by a number of empirical papers (e.g., Covin et al., 2006).

Innovativeness refers to the willingness and capability of the firm to embrace and to engage in new ideas, novelty, experimentation, and creative processes (Lumpkin & Dess, 1996). One sample item for innovativeness is “We have a strong emphasis on R&D, technological leadership, and innovations”. I averaged ratings on the three items to form the innovativeness index. The composite reliability for the innovativeness measurement was 0.816, which shows a good internal consistency (Hair et al., 2010). The Cronbach’s alpha for innovativeness scale was 0.790, indicating an adequate reliability (Cronbach, 1951).

Proactiveness is defined as a posture of anticipating and acting on future needs and trends, thereby creating first-mover advantages over competitors (Lumpkin & Dess, 1996). One sample item for proactiveness is “We tend to be ahead of competitors regarding introduction of products and ideas”. I averaged ratings on the three items to form the proactiveness index. The composite reliability for the proactiveness measurement was 0.773, which shows an adequate internal consistency (Hair et al., 2010). The Cronbach’s alpha for bricolage scale was 0.772, indicating a good reliability (Cronbach, 1951).
Risk-taking refers to a company’s proclivity for risk projects with chances of high returns or high losses and implies a willingness to act boldly even without knowing all potential consequences (Wilklund & Shepherd, 2003). One sample item for risk-taking is “We see bold, wide-ranging acts are necessary to achieve the firm’s objectives”. I averaged ratings on the three items to form the risk-taking index. The composite reliability for the risk-taking measurement was 0.823 and the Cronbach’s alpha for bricolage scale was 0.814, indicating a good reliability (Cronbach, 1951; Hair et al., 2010).

**Independent variables**

**Bricolage**

Bricolage was defined as making do by applying combinations of resource at hand for new problems and opportunities (Baker & Nelson, 2005). It was measured by eight items that capture behaviors related to acting based on scarce resource at hand. The respondents were asked how they recombine existing resource at hand when they face new problems or opportunities. The scale was first introduced by Senyard et al. (2014) and validated by (Davidsson et al., 2017). It was proved to have high reliability and validity in other studies (e.g., Stenholm & Renko, 2016; Wu et al., 2017). One sample item is “We are confident of our ability to find workable solutions to new challenge by using our existing resources.” All items were measured on a Likert scale ranging from 1 = totally disagree to 5 = totally agree. I averaged ratings on the eight items to form the bricolage index. The composite reliability for the bricolage measurement was 0.954, which shows a good internal consistency (Hair et al., 2010). The Cronbach’s alpha for bricolage scale was 0.957, indicating a high level of reliability (Cronbach, 1951).
Control variables

It is necessary to control for variables which may influence bricolage as well as EO when assessing the relationship between EO and bricolage.

Firm age. Younger firms may face a more penurious environment when exploiting opportunities due to their small resource base (Stam & Elfring, 2008). Therefore, younger firms may be more likely to engage bricolage since penurious environment is a catalyst for bricolage (Baker & Nelson, 2005). In addition, firm age may also relate with EO as the innovative capability tends to decrease when firms grow older (Thornhill & Amit, 2003), younger firms may be forced to rely on calculated risks in order to survive and grow (Pfeffer & Salancik, 2003), and the weak resource position of young firms may limit their capability to behave proactively (Lumpkin, Wales, & Ensley, 2006). Thus I control for firm age in the data analysis. Firm age was measured by the number of years since the business was founded (De Clercq et al., 2010).

Firm size. Larger firms generally have more access to resources (Wales, Patel, Parida, & Kreiser, 2013). On one hand, it may influence EO because with more resources firms are more capable to engage in entrepreneurial activities (Wilklund & Shepherd, 2003). On the other hand, more resources may decrease intention to engage in bricolage behavior (Desa & Basu, 2013). I therefore control for firm size in this study. Firm size was measured by the natural log of firm’s number of employees (Vomberg, Homburg, & Bornemann, 2015).

Revenue. Revenue directly influences the amount of resources a firm can have. The degree of resource adequacy or scarcity may impact bricolage (Fisher, 2012). Further, resources may also influence EO since the implementation of EO requires resource
commitment (Lumpkin & Dess, 1996). Therefore, I control for revenue, which was measured as the revenue of respondent’s business in last fiscal year.

*Industry competitiveness.* The environment of the firm also plays an important role in altering the effectiveness of EO (Lumpkin & Dess, 1996). Industry competitiveness may play a role in EO because firms are more likely to engage in EO in a more competitive environment (Lumpkin & Dess, 1996; Stam & Elfring, 2008). Therefore, I control for industry competitiveness, which was measured by 5 point Likert skill ranging from 1 (not competitive) to 5 (extremely competitive) (Zhou et al., 2005).

**Analytical Strategy**

Before I tested the hypothesized relationships, I first ran Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to test the reliability and validity of the measurements. Reliability will be tested by using Cronbach’s α (Cronbach, 1951) and composite reliability (Fornell & Larcker, 1981). As long as the indicators exceed the required minimum 0.7, the reliability standard will be met. Convergent validity of the constructs will be tested by referring item loadings and their significance (Bagozzi & Yi, 1988). If the loadings are all greater than the suggested minimum of 0.5 and statistically significant, the variables should have adequate convergent validity. Discriminant validity will be tested by comparing the correlation between every pair of constructs and the square root of the average variance extracted (AVE) of each variable (Fornell & Larcker, 1981). If the former is smaller than the later, the criteria for discriminant validity will be met. After that I ran SEM to test the hypothesized relationships. The statistics programs that were used are SPSS (19.0 version) and Amos (17.0 version).
Pilot Study

Prior to mailing to the respondents, I conducted pilot study to detect if there are ambiguities in terms, meanings, and issues with the questionnaire. First of all, I invited 3 Ph.D. colleagues who are majored in entrepreneurship to review the measurements. Subsequently, I distributed the questionnaires to 27 small business owners and/or managers and asked them to fill the questionnaire and identify if there are any ambiguous terms or sentences in the survey. I made minor changes to the questionnaires where the respondents thought are ambiguous. In the innovativeness scales, “One of the main goals is to launch many new lines of products in next three years” was changed to “One of the main goals is to launch many new lines of products/services in next three years” to capture the service part in innovation. In the bricolage scales, “When we face new challenges, we put together workable solutions from our existing resources” was changed to “When we face new challenges, we prefer to create solutions from our existing resources rather than acquiring new resources” to emphasize the choice of using existing resources. The Cronbach’s alpha was run to test the reliability of the measurements. The Cronbach’s alpha for each variable ranges from 0.773 to 0.858. Specifically, Cronbach’s alpha is 0.858 for innovativeness, 0.826 for proactiveness, 0.773 for risk-taking, and 0.807 for bricolage. The Cronbach’s alpha for innovativeness, proactiveness, and risk-taking are roughly consistent with that of other studies such as Brettel, Chomik, and Flatten (2015), where the Cronbach’s alpha for innovativeness, proactiveness, and risk-taking are 0.83, 0.79, and 0.77 respectively. The Cronbach’s alpha for bricolage (0.807) is comparable with Senyard et al. (2014), where Cronbach’s alpha for bricolage is 0.820.
Since the numbers are all greater than the threshold 0.7 (Cronbach, 1951), it should be safe to conclude that the measurements have adequate reliability.

**Factor Analysis**

An EFA was performed to uncover the underlying factor structure and the distinctiveness of the latent variables. The results of the EFA with principal component extraction and Varimax rotation result in a four-factor solution. The four factors explain 75.13% of the variance and each factor has an Eigenvalue greater than 1. As shown in table 2.3, the loadings for each item are greater than 0.7 and there are no high cross loadings, suggesting all variables have adequate discriminant validity.
Table 2.3: Exploratory Factor Analysis

<table>
<thead>
<tr>
<th>Model construct</th>
<th>Measurement item</th>
<th>Varimax-rotated loadings factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Innovativeness</td>
<td>inno1</td>
<td>.402</td>
</tr>
<tr>
<td></td>
<td>inno2</td>
<td>.290</td>
</tr>
<tr>
<td></td>
<td>inno3</td>
<td>.094</td>
</tr>
<tr>
<td>Proactiveness</td>
<td>pro1</td>
<td>.127</td>
</tr>
<tr>
<td></td>
<td>pro2</td>
<td>.065</td>
</tr>
<tr>
<td></td>
<td>pro3</td>
<td>-.094</td>
</tr>
<tr>
<td>Risk-taking</td>
<td>risk1</td>
<td>-.069</td>
</tr>
<tr>
<td></td>
<td>risk2</td>
<td>-.231</td>
</tr>
<tr>
<td></td>
<td>risk3</td>
<td>-.161</td>
</tr>
<tr>
<td>Bricolage</td>
<td>brico1</td>
<td>.856</td>
</tr>
<tr>
<td></td>
<td>brico2</td>
<td>.871</td>
</tr>
<tr>
<td></td>
<td>brico3</td>
<td>.870</td>
</tr>
<tr>
<td></td>
<td>brico4</td>
<td>.851</td>
</tr>
<tr>
<td></td>
<td>brico5</td>
<td>.835</td>
</tr>
<tr>
<td></td>
<td>brico6</td>
<td>.866</td>
</tr>
<tr>
<td></td>
<td>brico7</td>
<td>.867</td>
</tr>
<tr>
<td></td>
<td>brico8</td>
<td>.822</td>
</tr>
</tbody>
</table>

| Sum of squares (eigenvalue) | 7.355 | 2.552 | 1.571 | 1.294 |
| Cumulative variance explained (%) | 36.541 | 49.667 | 62.471 | 75.125 |

Note: Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Bolded numbers are factor loadings for each component
a. Rotation converged in 5 iterations.

I then conducted CFA to test the validity of the measurement model by using the software program Amos 17.0. As shown in table 2.4, the results indicate that the measurement model has acceptable fit ($\chi^2$(109) = 198.676 ($p < .001$); $\chi^2$/df = 1.82; CFI = 0.961; IFI = 0.962; TLI = 0.951; RMSEA = 0.067). Since the value of CFI, IFI, and TLI.
are all greater than the threshold 0.9 and the value of RMSEA is lower than the threshold 0.08, the measurement model fits well with the data.

Convergent validity of the constructs was established by using item loadings and their significance. As shown in table 2.4, the factor loadings of items on their respective constructs, ranging from 0.503 to 0.978, are all greater than the suggested minimum of 0.5 and statistically significant, suggesting that the constructs have convergent validity (Bagozzi & Yi, 1988). Next, I compared the correlation between every pair of constructs and the square root of the average variance extracted (AVE) of each variable. Discriminant validity of the constructs can be established if the AVE for one construct is greater than the absolute values of the standardized correlations of the given construct with any other construct (Fornell & Larcker, 1981). As suggested by table 2.4 and 2.5, discriminant validity was evident because the correlation between every pair of constructs was found to be below the square root of the AVE of each variable. Reliability was tested by referring to Cronbach’s α (Cronbach, 1951) and composite reliability (Bagozzi & Yi, 1988). The Cronbach’s α for each construct ranges from 0.772 to 0.957, exceeding the required minimum of 0.7. In addition, the composite reliability value for each construct ranges from 0.773 to 0.954, above the suggested minimum of 0.7. Altogether, these results demonstrate the validity and reliability of the measurement model.
Table 2.4: Confirmatory Factor Analysis for Measures

<table>
<thead>
<tr>
<th>Constructs and Items</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Innovativeness</strong> ($\alpha = .790; CR = .816; AVE = .611$)</td>
<td></td>
</tr>
<tr>
<td>(1) We have a strong emphasis on R&amp;D, technological leadership, and innovations</td>
<td>0.978</td>
</tr>
<tr>
<td>(2) Changes in product or service lines have usually been quite dramatic to achieve competitive advantage</td>
<td>0.790</td>
</tr>
<tr>
<td>(3) One of the main goals is to launch many new lines of products/services in next three years</td>
<td>0.503</td>
</tr>
<tr>
<td><strong>Proactiveness</strong> ($\alpha = .772; CR = .773; AVE = .534$)</td>
<td></td>
</tr>
<tr>
<td>(1) We tend to be ahead of competitors regarding introduction of products and ideas</td>
<td>0.786</td>
</tr>
<tr>
<td>(2) We typically initiate actions which competitors then respond to</td>
<td>0.759</td>
</tr>
<tr>
<td>(3) We are often the first to introduce new products and services, new ways to produce these, or new administrative methods.</td>
<td>0.638</td>
</tr>
<tr>
<td><strong>Risk-taking</strong> ($\alpha = .814; CR = .823; AVE = .612$)</td>
<td></td>
</tr>
<tr>
<td>(1) We see bold, wide-ranging acts are necessary to achieve the firm’s objectives</td>
<td>0.673</td>
</tr>
<tr>
<td>(2) We have a strong aptitude for high-risk projects (with chances of high returns)</td>
<td>0.921</td>
</tr>
<tr>
<td>(3) My firm typically adopts a bold posture when confronted with decisions involving uncertainty, to maximize the exploitation of opportunities</td>
<td>0.731</td>
</tr>
<tr>
<td><strong>Bricolage</strong> ($\alpha = .957; CR = .954; AVE = .723$)</td>
<td></td>
</tr>
<tr>
<td>(1) When we are facing new challenges we are confident in our ability to find workable solutions by using our existing resources.</td>
<td>0.898</td>
</tr>
<tr>
<td>(2) We willingly take on a broader set of challenges than our available resources</td>
<td>0.890</td>
</tr>
</tbody>
</table>
resources allow us to do.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) When responding to a new problem or opportunity, we use any existing resource that seems useful for this purpose.</td>
<td>0.897</td>
</tr>
<tr>
<td>(4) We face new challenges by combining our existing resources with external resources that are available to us inexpensively.</td>
<td>0.877</td>
</tr>
<tr>
<td>(5) When dealing with new problems or opportunities, we consider using the existing resources as a workable solution.</td>
<td>0.803</td>
</tr>
<tr>
<td>(6) We take on a surprising variety of new challenges with the resources that we have.</td>
<td>0.829</td>
</tr>
<tr>
<td>(7) When we face new challenges, we prefer to create solutions from our existing resources rather than acquiring new resources.</td>
<td>0.820</td>
</tr>
<tr>
<td>(8) We combine resources to accomplish new challenges that the resources were not originally intended to accomplish.</td>
<td>0.777</td>
</tr>
</tbody>
</table>

*Note. α = Cronbach’s α; AVE = average variance extracted; CR = composite reliability. Model fit statistics: $\chi^2(109) = 198.676$ ($p < .001$); $\chi^2/df = 1.82$; CFI = 0.961; IFI = 0.962; TLI = 0.951; RMSEA = 0.067. All factor loadings are significant at the .01 level.

**Common method bias and multicollinearity**

Likewise, several procedures suggested by Podsakoff et al. (2003) were used to address the common method bias. First, in the beginning of the survey I assured the respondents that there are no absolutely right or wrong answers in the survey and they can withdraw the survey anytime. This can help to limit respondents’ concerns such as evaluation apprehension and social desirability (Tang et al., 2015). Second, I mixed the order between the measurements of IV and the measurements of DV to decrease the participants’ perception of any connection between IV and DV as well as between constructs (Fulmer et al., 2009). Finally, I used Harman (1976) one-factor test to detect if this issue exists in this paper. The factors with eigenvalues greater than 1.0 account for
75.13% of the total variance. The largest factor does not account for a majority of the variance (36.54%). Thus common method variance was not detected in this study.

The variance inflation factor for each independent variable was lower than the suggested threshold of 4, which suggests the absence of multicollinearity (Chatterjee & Hadi, 2015).

RESULTS

Table 2.5 provides the means, standard deviations, and correlations. The sample firms have 37.93 employees on average, with a minimum 5 employees and maximum 145 employees. The firm age ranges from one year old to eight years old with a mean age of 5.32 years. The average revenue, measured as the revenue of the last physical year, was between $1.5 million to $2 million. The sample firms face relatively high industry competitiveness with a mean score of 3.31. The sample firms have relatively low levels of innovativeness and risk-taking with a mean value of 2.29 and 2.88 respectively. However, they have moderately high levels of proactiveness with a mean value of 3.05. The mean score for bricolage is 2.59, which is at a relatively low level.

The results of SEM were displayed in Figure 5. The fit index is: $\chi^2(111) = 215.323 \ (p < .001); \ \chi^2/df=1.940; \ CFI = 0.955; \ IFI = 0.955; \ TLI = 0.945; \ RMSEA = 0.072.$
Table 2.5: Means, Standard Deviations, and Correlations

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Firm size</td>
<td>37.93</td>
<td>22.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Firm age</td>
<td>5.32</td>
<td>2.06</td>
<td>.148*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Revenue</td>
<td>4.12</td>
<td>1.36</td>
<td>.439**</td>
<td>.147*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Industry Competitiveness</td>
<td>3.31</td>
<td>0.93</td>
<td>.106</td>
<td>-.036</td>
<td>.066</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Innovativeness</td>
<td>2.29</td>
<td>1.09</td>
<td>.076</td>
<td>.089</td>
<td>.007</td>
<td>.020</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Proactiveness</td>
<td>3.05</td>
<td>0.98</td>
<td>-.115</td>
<td>-.040</td>
<td>-.226**</td>
<td>-.035</td>
<td>.041</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Risk-taking</td>
<td>2.88</td>
<td>1.05</td>
<td>-.161*</td>
<td>-.024</td>
<td>.023</td>
<td>.093</td>
<td>-.294**</td>
<td>-.330**</td>
<td></td>
</tr>
<tr>
<td>8. Bricolage</td>
<td>2.59</td>
<td>1.07</td>
<td>.046</td>
<td>.017</td>
<td>.003</td>
<td>.058</td>
<td>.508**</td>
<td>.090</td>
<td>-.330**</td>
</tr>
</tbody>
</table>

Note: N = 183.
*p < .05. **p < .01.

Test of hypotheses

In hypothesis 2.1, it was proposed that bricolage is positively related to innovativeness of new firms. As shown in Figure 5, the finding supports this hypothesis (β = 0.587; p < 0.001).

In hypothesis 2.2, it was predicted that bricolage is positively related to proactiveness of new firms. As shown in Figure 5, this hypothesis was not supported (β = 0.173; p >0.1).

In hypothesis 2.3, it was predicated that bricolage is negatively related to risk-taking of new firms. As shown in the results, hypothesis 2.3 was supported (β = -0.406; p <0.01).
Figure 5: Results of Structural Equation Modeling

\[ N=183 \]
\[ **p < 0.01; ***p < .001 \]

Fit index: \( \chi^2(111) = 215.323 \) (p < .001); \( \chi^2/df = 1.940; \) CFI = 0.955; IFI = 0.955; TLI = 0.945; RMSEA = 0.072

Robustness checks

Next I split the whole sample into several subsamples by firm age, size, and industry and then I ran the same analysis to see if the results still hold. First of all, I excluded the firms that do not have ten firms in an industry, thus giving me a new sample of 170 firms. The data analysis for this new sample shows that the results for all the hypotheses hold. For hypothesis 2.1, \( \beta = 0.502; p < 0.001 \). For hypothesis 2.2, \( \beta = 0.238; p > 0.1 \); For hypothesis 2.3, \( \beta = -0.476; p < 0.01 \).

I then split the sample into two sub-samples by the firm size. One sub-sample includes 82 firms with less than 30 employees (including 30). The other sub-sample includes 101 firms with more than 30 employees. I ran the same analysis for these two sub-samples. For the first sub-sample, the results hold. For hypothesis 2.1, \( \beta = 0.567; p < 0.001 \); For
hypothesis 2.2, $\beta = 0.157; p > 0.1$; For hypothesis 2.3, $\beta = -0.439; p < 0.05$. Although the p value for the third hypothesis became a little bit bigger than that in the original analysis (from less than 0.01 to less than 0.05), it does not affect the results. For the second sub-sample, the results also hold. For hypothesis 2.1, $\beta = 0.427; p < 0.001$; For hypothesis 2.2, $\beta = 0.156; p > 0.1$; For hypothesis 2.3, $\beta = -0.377, p < 0.001$.

Finally, I split the sample by their revenue. I got the first sub-sample with 75 firms with lower than 1.5 million annual revenues. The second sub-sample includes 72 firms with more than 2 million annual revenues. Again, I ran the same analysis for these two sub-samples. For the first sub-sample, the results hold. For hypothesis 2.1, $\beta = 0.528; p < 0.001$; For hypothesis 2.2, $\beta = 0.386, p > 0.1$; For hypothesis 2.3, $\beta = -0.298; p < 0.01$. For the second sub-sample, the results still hold. For hypothesis 2.1, $\beta = 0.578; p < 0.001$; For hypothesis 2.2, $\beta = 0.178; p > 0.1$; For hypothesis 2.3, $\beta = -0.472; p < 0.01$.

The robustness checks suggest that the results in this paper have a high level of validity.

**DISCUSSION**

Although the outcomes of bricolage have been extensively studied in the literature, the relationship between bricolage and EO has received very little empirical attention. Theoretical linkages could be expected between bricolage and EO. The literature review of EO suggested that EO could be associated with behaviors of recombining existing resources (Alvarez & Busenitz, 2001; Dess et al., 1999; Lumpkin & Dess, 2001; Wu, 2007). By definition, bricolage is a behavior that makes do by applying combinations of existing resources at hand. Therefore, bricolage might be inherently associated with EO. As earlier discussed, bricolage might contribute to each dimension of EO. Therefore, drawing on EO literature and bricolage research, I investigated the influence of bricolage
on the three sub-factors of entrepreneurial orientation—innovativeness, proactiveness, and risk-taking.

Consistent with the prediction, bricolage was found to have a positive linear relationship with innovativeness, that is, bricolage is positively related to innovativeness orientation of new firms. This finding suggested that firms engaging behaviors by making do with their existing resources are likely to cultivate innovativeness orientation. As discussed earlier, recombining resources may result in innovative outcomes (Henderson & Clark, 1990; Keupp & Gassmann, 2013; Nelson & Winter, 2009). Therefore, firms engaging in bricolage behavior may promote innovativeness orientation which orientates firms to pursue their innovation goals. Additionally, the translation from innovativeness to performance requires the production of new products, services, and processes, a procedure that involves resources commitment internally and/or externally (Damanpour, 1991). Given the resource-constrained context for most new firms and their difficulty in seeking external support (Shane & Cable, 2002), bricolage acts as an alternative pathway for innovativeness-oriented firms to pursue their innovative goals.

Bricolage was found no significant relationship with proactiveness. This result suggested that bricolage is not an origin of proactiveness orientation. Bricolage behaviors do not necessarily lead to higher or lower proactiveness. One possible explanation of this finding is that proactive firms may tend to seek external resources rather than make do with their existing resources. Proactiveness orientation leads firms to strive for first mover in the market (Lumpkin & Dess, 1996). They endeavor to provide new products or services ahead of their competitors and to pursue many future opportunities. This may require a considerable amount of resource commitment (Hoegl et al., 2008). Therefore,
proactive firms might be pushed to seek resources from outside. As can be observed in the real world, the first movers tend to seek external resources, such as venture capital, to create or maintain their first mover advantage. This finding does not necessarily indicate that proactive firms do not engage in bricolage at all. Compared with relying on internal resources, however, proactive firms might be more likely to rely on external resources to achieve their firm goals.

As expected, bricolage was found to have a negative impact on risk-taking. Firms engaging in bricolage behaviors have lower intent to involve risk-taking activities. As I discussed previously, this might because bricolage inherently involves fewer risks than seeking external resources, which may associate with more unpredictable consequences. Risk-taking firms are likely to pursue bold goals so that the existing resources might not be sufficient to pursue such goals. Risk-taking is associated with a tendency to undertake costly diversification into new products or services (Sapienza et al., 2005). This may result in increasing investments and lead firms to over-commit resources (Shan et al., 2016). Therefore, a risk-taking firm may tend to seek outside resources rather than exploit their internal resources. In the real world, for example, it was found that risk-taking firms are more likely to engage in resource-seeking behaviors, such as accruing heavy debt (Shan et al., 2016). Compared with seeking external resources, making do with existing resources has lower risks and is unlikely to cultivate risk-taking orientation.

**IMPLICATIONS FOR THEORY**

First, this study contributes to bricolage literature by finding the positive influence of bricolage on one of the components of EO: innovativeness. This finding helps to enhance our scholarly understanding about the outcomes of bricolage. It provides evidence that
bricolage could make a firm more entrepreneurial oriented in terms of innovativeness. It also sheds light on how EO is cultivated (i.e., through what actions) in the context of resource constraints.

Second, this study contributes to the EO literature by enriching the origins of EO. The positive link between bricolage and innovativeness corresponds with the argument that EO could be associated with behaviors of recombining existing resources (Alvarez & Busenitz, 2001; Dess et al., 1999; Lumpkin & Dess, 2001; Wu, 2007). The negative relationship between bricolage and risk-taking also makes contribution to literature on the origins of EO. This finding suggests what factors do not drive EO, thus helping to draw a more complete picture of the antecedents of EO.

**IMPLICATIONS FOR PRACTICE**

This paper contributes to practice by helping entrepreneurs to identify the factor that influences EO, which may, in turn, affects firm performance. Particularly, the finding suggests that bricolage behaviors facilitate innovativeness orientation in a firm. As said previously, EO was found to have a positive impact on firm performance (e.g., Anderson & Eshima, 2013; Barringer & Bluedorn, 1999; Covin & Lumpkin, 2011; Covin & Miller, 2014; Rauch et al., 2009; Wang & Juan, 2015). Therefore, it is meaningful for practitioners to learn the drivers of EO so that they can promote such behavior to achieve desired firm performance. As suggested in this paper, entrepreneurs in new firms may want to engage in bricolage behavior to improve the overall innovativeness postures of their firms. The finding also suggests that bricolage behaviors are likely to lead to lower risk-taking. Engaging in too much bricolage will not be helpful for firms that want to pursue risky goals. Therefore, if firms are willing to engage in bricolage behaviors while
pursuing risky goals, they may need to balance how risky the goals should be and at what levels they want to engage in bricolage.

LIMITATIONS AND FUTURE RESEARCH

I acknowledge three main limitations of this study, which may provide avenues for future research. First, the data of this study were cross-sectional, which may affect the causal inferences about the findings of this study. Although I tried to provide solid theoretical reasoning for the relationship direction from bricolage to EO, the reverse causal direction cannot be completely eliminated due to the cross-sectional data. For example, one could argue that firms that are more innovativeness oriented will be more likely to adopt bricolage behavior. Therefore, I encourage future research to apply a longitudinal design to capture the causal relationships between bricolage and EO.

Second, a single informant, i.e., a business owner or manager, completed the survey. This may result in common method bias. I took actions such as assuring the respondents of their confidentiality to minimize this issue. I also ran the one-factor analysis (Harman, 1976) to detect this issue. The results suggested that common method bias was not a problem in this study. Despite this, future studies may need to consider collecting data from different sources to minimize the potential bias resulting from single informant.

Third, the data in this study drew from new firms in America. One should be cautious when applying the findings of this study to other contexts, such as emerging economies, which are different from the context in this study. Future research can replicate this study in a different context, such as an emerging economy, to see if the results hold. Another research direction lies in the boundary conditions of the relationship between bricolage and EO. In this study, I did not find the significant relationship between bricolage and proactiveness and I found a negative relationship between bricolage and risk-taking. This
might introduce an opportunity to explore the contingent variables in these relationships. For instance, it could be that bricolage will influence proactiveness in certain boundary conditions.

**CONCLUSION**

In this paper, I examine the influence of bricolage on the three sub-factors of entrepreneurial orientation—innovativeness, proactiveness, and risk-taking. This is the first paper done in an attempt to establish a causal link between bricolage and sub-dimensions of EO. Drawing on a survey data from 183 entrepreneurs, I found that bricolage has a positive impact on innovativeness and a negative impact on risk-taking. Based on the results, bricolage is likely to drive innovativeness postures. Firms with higher levels of bricolage, however, are less likely to engage in risk-taking behavior. Inconsistent with the predictions, bricolage has no significant relationship with proactiveness.

The findings of this paper contribute to the bricolage and EO literature by revealing that bricolage influence two components of EO: innovativeness and risk-taking. The findings have practical implications for entrepreneurs such that they can cultivate their innovativeness orientation by engaging in bricolage behaviors in their firms.

In the following essay, I will examine the contingent factors in the relationship between resource constraints and bricolage. Given the link between resource constraints and bricolage that I found in the first essay, it would be interesting to explore how individual-level factors strengthen or weaken this relationship because bricolage is a behavior that individuals, such as firms’ owners, CEOs, or managers, execute. The following essay seeks to understand how entrepreneurs’ creativity cognitive style moderates the relationship between resource constraints and bricolage.
Essay Three: Resource Constraints and Bricolage: the Moderating Role of Entrepreneurs’ Creativity Cognitive Style

INTRODUCTION

As shown in the first essay, resource constraints have a positive impact on the engagement of bricolage. To deepen the understanding of this relationship, in this paper, I seek to explore factors that may moderate the relationship between resource constraints and bricolage. In particular, I look at how the individual-level variable, creativity cognitive thinking, moderates this relationship. Bricolage is a behavior that individuals, such as firms’ owners, CEOs, or managers, execute (Baker & Nelson, 2005). Therefore, individual-level factors are important for understanding why entrepreneurs engage in bricolage behaviors. This importance encouraged me to examine the individual factors in the relationship between resource constraints and bricolage.

As discussed earlier, the consequences of bricolage have been extensively examined, while relatively little research has been done to unravel the antecedents of bricolage (Stenholm & Renko, 2016). This represents a significant gap in the bricolage research because we still know little about the origins of bricolage behaviors. Therefore, the third essay seeks to investigate the predictors of bricolage. In particular, I will look at how creativity cognitive style interacts with resource constraints to influence bricolage.

According to research on cognitive psychology, cognitive style refers to consistent individual differences in perceiving and solving problems (Armstrong et al., 2012). It is an individual’s consistent approach to organizing and processing information during thinking (Riding & Sadler - Smith, 1997). Cognitive style is widely considered a
determinant of individual behavior (Allinson et al., 2000; Armstrong et al., 2012). Research suggests that the entrepreneurial cognition represents many important implications for new venture outcomes (Baron, 2004; Mitchell et al., 2002). Therefore, different cognitive styles may lead to different perceptions and behavioral tendencies when entrepreneurs face penurious environments. Creativity cognitive style is defined as individual differences in perceiving, behaving, solving problems, taking decisions, and relating to others in the creative process (Chen et al., 2015).

Creativity cognitive style is expected to be associated with bricolage because bricolage is a form of behavior that inherently involves with creatively recombining existing resources (Baker & Nelson, 2005). When firms engage in bricolage, they combine the existing resources that would otherwise be discarded. This requires them to combine resources in creative ways because some of the existing resources at hand are not standard resources. Therefore, the creative thinking might play a role in the bricolage process.

In particular, I expected the two components of creativity cognitive style, divergent thinking and convergent thinking, to have a distinct moderating impact on the engagement of bricolage. Divergent thinking involves producing multiple answers from available information. Divergent thinkers can make unexpected combinations and recognize connections among remote relations (Cropley, 2006). On the contrary, convergent thinking involves narrowing down the different alternatives and achieve a definite solution (Cropley, 2006).

Both divergent and convergent thinking are considered as stable cognitive style. They are consistent individual differences in perceiving and solving problems (Armstrong et al.,
2012; Riding & Sadler-Smith, 1997). For instance, McCrae, Arenberg, and Costa (1987) found that individual differences in divergent thinking are quite stable in a six-year stability of divergent thinking test. Furthermore, Chamorro-Premuzic and Reichenbacher (2008) demonstrated that divergent thinking and convergent thinking are stable characteristics and can be predicted by personality. Because of their stability, many studies have demonstrated the ability of divergent thinking and convergent thinking to consistently predict certain aspects of performance on creative problem-solving tasks (e.g., Mumford, Marks, Connelly, Zaccaro, & Johnson, 1998; Runco, 1991). The stability of divergent thinking and convergent thinking makes it possible to relate them with behavioral tendencies. Basadur and Hausdorf (1996) argued that divergent thinking and convergent thinking can bring about different behavioral tendencies. By following this lead, this study was done to investigate the different moderating effects of divergent thinking and convergent thinking on the engagement of bricolage.

People with divergent thinking generally have the ability to produce multiple and original ideas (Mumford & Gustafson, 1988). They perceive the world beyond the conventional viewpoints (Chen et al., 2015) and are more likely to see things in different ways (Reid, de Brentani, & Kleinschmidt, 2014). Therefore, divergent thinkers are likely to make use of the resources in ways for which they were not originally designed. However, the “single best answer” thinking style (Cropley, 2006) of convergent thinking may lead convergent thinkers to ignore other uses of resources other than its original use. This may attenuate the possibilities of engaging in bricolage because bricolage inherently involves with finding new uses of existing resources. Therefore, I expected divergent thinking to have a positive moderating effect in the relationship between resource
constraints and bricolage, whereas convergent thinking will negatively moderate the relationship between resource constraints and bricolage. Please see figure 6 for the conceptual model of this essay.

The goal of this paper is to make the following three contributions. First, it contributes to the entrepreneurial bricolage literature by unfolding how individual-level factors interact with resource constraints to influence bricolage. Second, the aim of this paper is to contribute to the creativity cognition research by testing how entrepreneurs’ divergent thinking and convergent thinking moderate the relationship between resource constraints and bricolage. By doing this, I hope to shed light on how entrepreneurs’ individual differences shape bricolage behaviors. Third, this paper will provide practical implications for entrepreneurs on what factors impact the engagement of bricolage behaviors, which may ultimately affect firm performance (Senyard et al., 2010).

THEORY AND HYPOTHESES

Key Constructs

Divergent thinking

Divergent thinking refers to the positive attitude towards generating many diverse ideas for one problem by perceiving the world beyond the conventional viewpoints (Chen et al., 2015). It involves making unexpected combinations and recognizing connections among remote associations (Cropley, 2006).

Different cognitive processes underlie divergent thinking. For example, divergent thinking can be understood as the end result of more specific cognitive processes underlying idea generation, such as the application of knowledge, analogical reasoning,
conceptual combination/reorganization (Mumford, 2003). In his seminal work, Guilford (1950) proposed that divergent thinking is a key capability underlying creative thought. Effective creative problem-solving requires the generation of varied and diverging potential solutions (Ford, 1996). Divergent thinking helps individuals to identify interesting problems and creative ways of implementing solutions (Basadur, 1991).

In the context of problem-solving, diverging ideas affect the originality of the problems identified, and the variety of the solutions proposed (Basadur, 1991; Basadur & Hausdorf, 1996; Ford, 1996). Many studies have shown that divergent thinking can predict certain aspects of performance on creative problem-solving tasks (Plucker & Renzulli, 1999; Runco, 1991). Indeed, divergent thinking relates very closely with creativity. It is considered a fundamental element of creativity (Paulus, 2000). Terms “divergent thinking” and “creativity” are sometimes used synonymously in psychology literature (McCrae, 1987).

With regard to the outcomes of divergent thinking, divergent thinking has been considered a predictor of entrepreneurship (Ames & Runco, 2005) and creative potential (Runco & Acar, 2012). Chermahini and Hommel (2012) found that divergent thinking led to a more positive mood. McCrae (1987) found that divergent thinking is positively associated with openness to experience, one of the big five personalities. With regard to the predictors of divergent thinking, a more positive mood and affect have been found to improve divergent thinking (Baas, De Dreu, & Nijstad, 2008; Davis, 2009).

It is worthwhile to mention that divergent thinking ability can be trained (Cropley, 2006). Many approaches to creative problem-solving training focus on increasing divergent thinking (Basadur, Graen, & Green, 1982).
**Convergent thinking**
In contrast, convergent thinking is oriented toward generating single best answer to a clear question. Convergent thinking is considered a cognitive thinking style that brings together information focused on solving a problem that has a single correct solution (Simonton, 2015). Convergent thinking is embodied in logical, analytical, and unprejudiced reasoning, which influences how individuals behave and relate to others (Armstrong et al., 2012). It focuses on logic, accuracy, and emphasizes on recognizing the familiar, reapplying set techniques, and accumulating information. Therefore, it is most effective in circumstances where a ready-made answer exists or problems can be solved by applying only conventional and logical search (Cropley, 2006). Convergent thinking leads to the single best answer. That is, answers are either right or wrong. Therefore, it leaves no room for ambiguity. Convergent thinking involves exploitation of existing knowledge by means of standard procedures. Convergent thinkers are not likely to seek new knowledge with creative ways of solving problems (Cropley, 1999).

**Resource constraints**
As discussed earlier in this dissertation, resource constraints describe situations where there are no sufficient resources to solve problems or pursue opportunities (Gibbert et al., 2007). It is opposed to resource adequacy or slack. As with the first essay, this paper also focuses on knowledge constraints and financial constraints. By adapting from Keupp and Gassmann (2013), in this paper I define knowledge constraints as the degree of lacking internal and external knowledge means to solve problems or pursue opportunities. Similarly, financial constraint is defined as the degree of lacking internal and external financial means to solve problems or pursue opportunities.
Entrepreneurial bricolage

Originally introduced by Levi-Strauss (1966), bricolage has been invoked in a wide range of social science disciplines, such as social psychology (Weick, 1993), innovation research (Ciborra, 1996; Garud & Karnøe, 2003), and entrepreneurship studies (Baker et al., 2003). It has also gained increasing attention in management and organization studies (Duymedjian & Rüling, 2010; Perkmann & Spicer, 2014). Bricolage is considered as the process that people use to combine the various resources they have at hand as a means of finding workable approaches to problems and opportunities (Levi-Strauss, 1966). It focuses on addressing opportunities and problems with existing undervalued or discarded resources that are often available for free or cheaply (Desa & Basu, 2013).

In the entrepreneurship literature, bricolage is defined as making do by applying combinations of the resources at hand to new problems and opportunities (Baker & Nelson, 2005). Prior literature has extensively examined the outcomes of bricolage (e.g., Garud & Karnøe, 2003; Halme et al., 2012; Senyard et al., 2014; Senyard et al., 2010; Stenholm & Renko, 2016). In the seminal work of entrepreneurial bricolage, Baker and Nelson (2005) found that resource-constrained firms that engage in bricolage have higher firm growth than those that do not engage in such behavior. Senyard et al. (2010), using longitudinal data of young firms, found that bricolage has a positive effect on firm sales. Likewise, Senyard et al. (2014) documented a positive relationship between bricolage and innovativeness of new firms. In addition, Salunke et al. (2013) evidenced that firms that engage in bricolage have higher supportive innovation performance. In the context of social entrepreneurship, Gundry et al. (2011) demonstrated that bricolage facilitates social entrepreneur’s catalytic innovation. In the context of international entrepreneurship, Desa (2012) illustrated that the selective use of bricolage help ventures to survive in weak
institutional environments. With regard to some recent works, Stenholm and Renko (2016) found that bricolage is positively related to new venture survival. An et al. (2017) demonstrated that bricolage drives corporate entrepreneurship by facilitating opportunity identification. Witell et al. (2017) argued that capabilities in making do with what organizations have at hand are positively associated with service innovation outcomes.

Although the consequences of bricolage have been extensively investigated, the origins of bricolage have remained poorly understood (Stenholm & Renko, 2016). The discussion about the predictors of bricolage mainly emphasizes the external environment (Desa & Basu, 2013; Welter & Xheneti, 2013). For example, Desa and Basu (2013) examined the environment-level antecedents of bricolage and found that ventures are more likely to use bricolage in environments of very low and very high resource munificence. Recently, scholars began to explore the individual-level determinants of bricolage behaviors. For instance, Stenholm and Renko (2016) found that entrepreneurs’ passion is positively related to bricolage.

Despite these efforts in the literature, we still know little about the predictors of bricolage, especially in the individual level. This motivates me to investigate the possible individual level predictors of bricolage in this essay.

Hypothesis Development

As discussed in the first essay, resource constraints may stimulate a variety of novel practices, such as recombination, to meet the challenges that firms face (Schulze & Hoegl, 2006). As cognitive psychology research has suggested, people are more creative to solve problems under conditions of resource scarcity (Durham et al., 2000; Moreau & Dahl, 2005). Thus, entrepreneurs may be pushed to seek novel resource recombination when
faced resource constraints (Bradley et al., 2011). For example, Mosakowski (2002) stated that firms with limited resources are more likely to make do with whatever resources at hand to launch innovation strategies and pursue firm goals. This line of reasoning suggests that resource constraints, conceptualized as knowledge constraints and financial constraints in this paper, is expected to trigger bricolage behavior. The empirical evidence in the first essay supports this proposition, that is, resource constraints are positively related to bricolage. The next sections will discuss how divergent thinking and convergent thinking moderate this relationship.

**The moderating role of divergent thinking**

Divergent thinking entails the ability to go beyond the boundaries of an established way of looking at things and see them in many different ways (Reid et al., 2014). Different cognitive processes underlie divergent thinking. For example, divergent thinking can be understood as the end result of more specific cognitive processes underlying idea generation, such as the application of knowledge, analogical reasoning, and conceptual combination/reorganization (Mumford, 2003). Divergent thinking reflects an individual’s general ability to produce multiple and original ideas (Mumford & Gustafson, 1988).

The rationales that divergent thinking might positively moderate the relationship between resource constraints and bricolage lie in the following two points. First, bricolage could be a viable pathway that divergent-thinking entrepreneurs choose when facing resource constraints. People with divergent thinking generally have the ability to produce multiple and original ideas (Mumford & Gustafson, 1988). Divergent thinkers may come up with more ideas with their richness of non-linear thought and imagination
(Basadur & Hausdorf, 1996). Therefore, divergent-thinking entrepreneurs tend to raise multiple combinations of resources to one single problem. They are able to make unexpected combinations, find connections between different associates, and convert information into unanticipated forms (Cropley, 2006). In the context of resource-constrained firms, entrepreneurs’ divergent thinking may lead to the behavioral tendencies of making do with existing resources by applying unexpected recombination, that is, bricolage. This line of reasoning suggests that divergent-thinking entrepreneurs may be more likely to engage in bricolage behaviors in the resource-constrained environment. Meanwhile, it should be noted that entrepreneurs with divergent thinking may not only choose to make do with existing resources as the solution to their problems but also may engage in some other behaviors, such as acquiring standard resources from the outside. Despite this, engaging in bricolage tends to be a highly possible approach for divergent-thinking entrepreneurs because bricolage is a behavioral path that is in line with the “unexpected combinations” in divergent thinking.

Second, entrepreneurs with divergent thinking tend to find other uses of resources, thus making use of the resources in ways for which they were not originally designed. Divergent-thinking people perceive the world beyond the conventional viewpoints (Chen et al., 2015) and are more likely to see things in different ways (Reid et al., 2014). Therefore, when they face problems, entrepreneurs with divergent thinking are likely to use resources at hand in ways for which they were not originally designed. In addition, divergent thinking depicts the ability to have as many appropriate answers as possible for the same question (McCrae, 1987). Therefore, entrepreneurs with divergent thinking are likely to have many new ideas on how to use resources and may find some alternative
uses for existing resources beyond the traditional purpose. Furthermore, divergent thinking also enables entrepreneurs to come up with different possible combinations of existing resources. The processes that entrepreneurs make do with existing resources by applying its new uses and new combinations and coming up with some unexpected outcomes is considered bricolage (Baker & Nelson, 2005).

Therefore, given the resource-constrained context, entrepreneurs with high levels of divergent-thinking are more likely to seek novel resource recombination of existing resources (Bradley et al., 2011) or come up with more novel ideas on how to recombine resources at hand, thus strengthening the relationship between resource constraints and bricolage. In contrast, entrepreneurs with low levels of divergent thinking are less likely or less capable of engaging in bricolage, thus weakening the relationship between resource constraints and bricolage. Based on this reasoning, I hypothesized that:

**Hypothesis 3.1**: Entrepreneurs’ divergent thinking will positively moderate the relationship between resource constraints and bricolage, such that the relationship will be stronger for entrepreneurs with high, as opposed to low, divergent thinking.

**The moderating role of convergent thinking**

In contrast with divergent thinking, convergent thinking is oriented to clarify the nature of a problem to narrow down the various possibilities and achieve a definite answer (Chen et al., 2015). Individuals with convergent thinking tend to solve problems by identifying very few solutions based on logic, fact, and linear thought. The rationales that convergent thinking might negatively moderate the relationship between resource
constraints and bricolage are as follows. First, convergent thinking is a cognitive process that requires reaching a definite solution, whereas bricolage may require a cognitive process that involves with creatively recombining resources in various ways. Bricolage is about the combination of existing resources for new uses (Fisher, 2012). It is not simply about making do through the reuse of old resources; instead it is about creative recombination of resources towards purposes for which they were not originally designed (Senyard et al., 2014). This process requires entrepreneurs to come up with different ways of combination to find out the optimal solution. Convergent thinking may hinder this process because it is the practice of trying to solve a discrete problem by selecting the optimal solution from a finite set. Therefore, when resource constraints trigger bricolage behaviors, entrepreneurs with convergent thinking may not be good at how to combine existing resources at hand.

Second, convergent-thinking people may exploit resources from its original design and not from its other uses. Due to the “single best answer” thinking style of convergent thinking, entrepreneurs with convergent thinking tend to ignore other uses of resources other than its original use. This type of thinking style largely decreases the possibilities of engaging in bricolage because bricolage inherently involves with finding new uses of resources. As stated above, bricolage requires bricoleurs to use resources in a way they are not originally intended (Baker & Nelson, 2005). Therefore, entrepreneurs with high convergent thinking may be less likely to engage in bricolage in the context of resource scarcity.

Third, a critical feature of convergent thinking is that it tends to find the single best answer, leaving no room for ambiguity(Cropley, 2006). When facing problems or
opportunities, convergent-thinking entrepreneurs tend to find a single answer to best
address the problem or opportunity. A high possibility exists that the single best answer
would be seeking resources from outside because seeking outside resources is a direct
and clear solution for many problems. In contrast, engagement of bricolage involves
tolerance for ambiguity, messiness, and setbacks (Baker & Nelson, 2005) because the
outcomes of bricolage are unexpected.

Therefore, I expected that given the resource-constrained context, entrepreneurs with
high levels of convergent thinking are less likely to apply a novel recombination of
existing resources (Bradley et al., 2011), thus weakening the positive relationship
between resource constraints and bricolage. In contrast, entrepreneurs with low levels of
convergent thinking are more capable of seeking novel use of resources at hand, thus
strengthening the relationship between resource constraints and bricolage. Taken together,
I hypothesized that:

*Hypothesis 3.2: Entrepreneurs’ convergent thinking will negatively moderate the
relationship between resource constraints and bricolage, such that the relationship will
be weaker for entrepreneurs with high, as opposed to low, convergent thinking.*
Figure 6: Conceptual Model of Essay 3

- Knowledge Constraints
- Financial Constraints
- Convergent Thinking
- Bricolage
- Divergent Thinking

H3.1+ and H3.2-
METHOD

Sample and Procedure
As with the first two essays, in this study I also collected data from the new firms, which are defined as firms of eight years of age or younger (Atuahene-Gima & Li, 2004). Data was also collected from ReferenceUSA, which includes verified and accurate information of more than 14 million U.S firms. It is a common practice to collect data from ReferenceUSA in management and entrepreneurship research (e.g., Baron & Tang, 2011; Baron et al., 2011; Egan et al., 2004; Hao & Song, 2016). For detailed sample collection procedure, please see the method section in essay one. In the end, I got 198 responses (19.8% response rate), including 161 early responses and 37 late responses. After withdrawing 15 incomplete responses, there were 183 usable responses. As suggested by Armstrong and Overton (1977), I assess the non-response bias by comparing the early and late respondents on the mean values of study variables and by comparing the mean responses of respondents and non-respondents on firm age, firm size, and sales revenues. The results suggest that there is no non-response bias. I also ran a paired comparison test, which indicates no significant differences in firm age, size, or sales revenues (t=0.47 for age; t=0.62 for size; t=0.43 for sales revenue, not significant) between firms that agreed to participate in this study and those that did not.

Measurement
Measurements were adapted from the extant literature. 5 Likert scale was used for the constructs below. Respondents were asked to rate their agreement for each statement from one (totally disagree) to five (totally agree). Please see appendix for the measurement items for each construct.
**Dependent variable**

Bricolage

Bricolage was measured by eight items scale that was first introduced by Senyard et al. (2014) and validated by (Davidsson et al., 2017). It was proved to have high reliability and validity in other studies (e.g., Stenholm & Renko, 2016; Wu et al., 2017). One sample item is “We are confident of our ability to find workable solutions to new challenge by using our existing resources.” All items were measured on a Likert scale ranging from 1 = totally disagree to 5 = totally agree. The composite reliability for the bricolage measurement was 0.954, which shows an adequate internal consistency (Hair et al., 2010). The Cronbach’s alpha for bricolage scale was 0.957, indicating a high level of reliability (Cronbach, 1951).

**Independent variables**

Knowledge constraints

By adapting from Keupp and Gassmann (2013), in this paper knowledge constraint is defined as the degree of lacking internal and external knowledge means to solve problems or pursue opportunities. The measurements of knowledge constraints was also adapted from Keupp and Gassmann (2013). One sample item for knowledge constraints is “My firm is missing R&D staff that is needed to accomplish our innovation objectives”. The composite reliability for the knowledge constraints scale was 0.916, indicating a good internal consistency (Hair et al., 2010). The Cronbach’s alpha for this measurement was 0.867, indicating a good reliability (Cronbach, 1951).

Financial constraints

Financial constraint is defined as the degree of lacking internal and external financial means to solve problems or pursue opportunities (Keupp and Gassmann, 2013). The
measurement for financial constraints was adapted from Keupp and Gassmann (2013). One sample item is “My firm is missing the external financial means to accomplish our innovation objectives”. The composite reliability for the financial constraints scale was 0.916, which shows an adequate internal consistency (Hair et al., 2010). The Cronbach’s alpha for this measurement was 0.814, indicating a good reliability (Cronbach, 1951).

**Moderators**

Divergent thinking

Divergent thinking refers to the positive attitude towards generating many diverse ideas for one problem by perceiving the world beyond the conventional viewpoints (Chen et al., 2015). It was measured by three items adapted from Basadur and Hausdorf (1996) and Cropley (2006). This measurement was also used in other studies (Chen et al., 2015). One sample item is “I enjoy stretching my imagination to produce many ideas.” The composite reliability for the divergent thinking measurement was 0.819, which shows an adequate internal consistency (Hair et al., 2010). The Cronbach’s alpha for bricolage scale was 0.843, indicating a high level of reliability (Cronbach, 1951).

Convergent thinking

Convergent thinking involves narrowing down the different alternatives and achieve a definite solution (Cropley, 2006). Convergent thinking was also measured by three items adapted from Basadur and Hausdorf (1996) and Cropley (2006). One sample item is “I like to identify the data and fact related to the problem.” The composite reliability for convergent thinking measurement was 0.861 and the Cronbach’s alpha for convergent thinking scale was 0.859, indicating a high level of reliability (Cronbach, 1951).

**Control variables**

In this paper, several variables were controlled to rule out the alternative explanation.
**Firm age.** Younger firms may face a more penurious environment when exploiting opportunities due to their small resource base (Stam & Elfring, 2008). Therefore, younger firms may be more likely to engage in bricolage since penurious environment is a catalyst for bricolage (Baker & Nelson, 2005). Therefore, I controlled for firm age, which was measured as the number of years since the business was founded.

**Firm size.** Larger firms usually have more resources (Wales, Gupta, et al., 2013). More resources may decrease intention to engage in bricolage behavior because bricolage usually happens when there are scarce resources in firms (Desa & Basu, 2013). I therefore controlled for firm size in this study. Firm size was measured by the natural log of firm’s number of employees (Vomberg et al., 2015).

**Revenue.** Revenue directly influences the amount of resources a firm can have. Firms with more revenue may have more resource slack that can be used to improve firm performance (Mishina et al., 2004). The degree of resource slack or scarcity may impact bricolage (Fisher, 2012). Therefore, I control for revenue, which was measured as the revenue of respondent’s business in last fiscal year.

**Pilot Study**

Prior to mailing to the respondents, I conducted pilot study to detect if there are ambiguities in terms, meanings, and issues with the questionnaire. First of all, I invited 3 Ph.D. colleagues who are majored in entrepreneurship to review the measurements. Minor changes were made to the measurements according to their feedbacks. For example, “My firm lacks the internal financial means” was changed to “My firm is missing the internal financial means to accomplish our innovation objectives” to better capture the real meaning of financial constraints. Subsequently, I distributed the
questionnaires to 27 small business owners and/or managers and asked them to fill the questionnaire and identify if there are any ambiguous terms or sentences in the survey. No changes were made according to their feedback. The Cronbach’s alpha was run to test the reliability of the measurements. The Cronbach’s alpha for each variable ranges from 0.799 to 0.857. Specifically, Cronbach’s alpha is 0.857 for knowledge constraints, 0.836 for financial constraints, 0.799 for divergent thinking, 0.856 for convergent thinking, and 0.807 for bricolage. The Cronbach’s alpha for knowledge constraints (0.857) and financial constraints (0.836) are comparable with Keupp and Gassmann (2013), where Cronbach’s alpha for knowledge constraints and financial constraints are 0.782 and 0.875 respectively. The Cronbach’s alpha for divergent thinking (0.799) and convergent thinking (0.856) are roughly comparable with Chen et al. (2015), where Cronbach’s alpha for divergent thinking and convergent thinking are 0.68 and 0.79 respectively. The Cronbach’s alpha for bricolage (0.807) is comparable with Senyard et al. (2014), where Cronbach’s alpha for bricolage is 0.820. Since the numbers are all greater than the threshold 0.7 (Cronbach, 1951), it should be safe to conclude that the measurements have adequate reliability.

**Analytical Strategy**

Again, before the hypothesized relationships were tested, I tested the reliability and validity of measurement model. First, EFA was run to confirm the unidimensionality of the variables in our model and the underlying factor structure. Reliability was tested by using Cronbach’s α (Cronbach, 1951) and composite reliability (Fornell & Larcker, 1981). The threshold for both indicators are 0.7. Discriminant and convergent validity of the constructs will be tested by applying CFA. Moderated hierarchical regressions were used to test the hypothesized relationships in our proposed model. By averaging the score
of items for each construct, it is appropriate to use hierarchical regression analysis. Some other studies use the same analytical strategy when they use the Likert scale items to measure IVs and DVs and then average them to run hierarchical regression analysis (e.g., Oldham & Cummings, 1996; Shin & Zhou, 2003). In the hierarchical regression analysis, the control variables were entered in the first step. Knowledge constraints and financial constraints were entered into the regression in the second step. Interaction terms (knowledge constraints * divergent thinking, knowledge constraints * convergent thinking, financial constraints * divergent thinking, and financial constraints * convergent thinking) were entered in the third step. In order to minimize the multicollinearity, I mean centered the independent variables and moderators before testing the moderating effect (Cohen et al., 2013). The statistics programs that were used are SPSS (19.0) and Amos (17.0).

**Factor Analysis**

An EFA was performed to confirm the underlying factor structure. The results of the EFA with principal component extraction and Varimax rotation result in a five-factor solution. The five factors explain 79.49% of the variance and each factor has an Eigenvalue greater than 1. As shown in table 3.1, all items were significantly loaded on their respective factors and there are no high cross loadings, suggesting all variables have adequate discriminant validity (Hair et al., 2010).
Table 3.1: Exploratory Factor Analysis

<table>
<thead>
<tr>
<th>Model construct</th>
<th>Measurement item</th>
<th>Varimax-rotated loadings factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Divergent thinking</td>
<td>div1</td>
<td>.174</td>
</tr>
<tr>
<td></td>
<td>div2</td>
<td>.307</td>
</tr>
<tr>
<td></td>
<td>div3</td>
<td>.056</td>
</tr>
<tr>
<td>Convergent thinking</td>
<td>con1</td>
<td>-.115</td>
</tr>
<tr>
<td></td>
<td>con2</td>
<td>-.339</td>
</tr>
<tr>
<td></td>
<td>con3</td>
<td>-.217</td>
</tr>
<tr>
<td>Knowledge constraints</td>
<td>knlg1</td>
<td>.142</td>
</tr>
<tr>
<td></td>
<td>knlg2</td>
<td>.166</td>
</tr>
<tr>
<td></td>
<td>knlg3</td>
<td>.212</td>
</tr>
<tr>
<td></td>
<td>knlg4</td>
<td>.271</td>
</tr>
<tr>
<td>Financial constraints</td>
<td>fin1</td>
<td>.322</td>
</tr>
<tr>
<td></td>
<td>fin2</td>
<td>.238</td>
</tr>
<tr>
<td>Bricolage</td>
<td>brico1</td>
<td>.835</td>
</tr>
<tr>
<td></td>
<td>brico2</td>
<td>.866</td>
</tr>
<tr>
<td></td>
<td>brico3</td>
<td>.862</td>
</tr>
<tr>
<td></td>
<td>brico4</td>
<td>.840</td>
</tr>
<tr>
<td></td>
<td>brico5</td>
<td>.833</td>
</tr>
<tr>
<td></td>
<td>brico6</td>
<td>.840</td>
</tr>
<tr>
<td></td>
<td>brico7</td>
<td>.822</td>
</tr>
<tr>
<td></td>
<td>brico8</td>
<td>.780</td>
</tr>
<tr>
<td>Sum of squares (eigenvalue)</td>
<td></td>
<td>9.316</td>
</tr>
<tr>
<td>Cumulative variance explained (%)</td>
<td></td>
<td>31.043</td>
</tr>
</tbody>
</table>


Bolded numbers are factor loadings for each component

a. Rotation converged in 5 iterations.

I then used the software program Amos 17.0 to further test the validity of the measurement model by conducting CFA. As shown in table 3.2, the value of CFI, IFI,
and TLI are all greater than the threshold 0.9. The value of RMSEA is lower than the
threshold 0.08. Specifically, the values are as follows: $\chi^2(155) = 308.801 \ (p < .001)$;
$\chi^2/df=1.99; \ CFI = 0.950; \ IFI = 0.951; \ TLI = 0.939; \ RMSEA = 0.074$. Therefore, the
measurement model shows acceptable fit.

Convergent validity of the constructs was established by using item loadings and their
significance. As shown in table 3.2, the factor loadings of items on their respective
constructs, ranging from 0.614 to 0.942, are all greater than the suggested minimum of
0.5 and statistically significant, suggesting that the constructs have convergent
validity (Bagozzi & Yi, 1988). Next, I compared the correlation between every pair of
constructs and the square root of the average variance (AVE) extracted of each variable.
Discriminant validity of the constructs can be established if the AVE for one construct is
greater than the absolute values of the standardized correlations of the given construct
with any other construct (Fornell & Larcker, 1981). As suggested by table 3.2 and 3.3,
discriminant validity was evident because the correlation between every pair of
constructs was found to be below the square root of the AVE of each variable. Reliability
was tested by referring to Cronbach’s $\alpha$ (Cronbach, 1951) and composite reliability
(Bagozzi & Yi, 1988). The Cronbach’s $\alpha$ for each construct ranges from 0.843 to 0.957,
exceeding the required minimum of 0.7. In addition, the composite reliability value for
each construct ranges from 0.819 to 0.954, above the suggested minimum of 0.7.
Altogether, these results demonstrate the validity and reliability of the measurement
model.
Table 3.2: Confirmatory Factor Analysis for Measures

<table>
<thead>
<tr>
<th>Constructs and Items</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Divergent thinking (α = .843; CR = .819; AVE = .604)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) I enjoy stretching my imagination to produce many ideas.</td>
<td>0.887</td>
</tr>
<tr>
<td>(2) I easily come up with unique ideas.</td>
<td>0.643</td>
</tr>
<tr>
<td>(3) I prefer to look at things from a non-traditional view.</td>
<td>0.783</td>
</tr>
<tr>
<td><strong>Convergent thinking (α = .859; CR = .861; AVE = .674)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) I like to take time to clarify the problem.</td>
<td>0.853</td>
</tr>
<tr>
<td>(2) I like to identify the data and facts related to the problem.</td>
<td>0.804</td>
</tr>
<tr>
<td>(3) I like to focus on the precise description of the problem.</td>
<td>0.805</td>
</tr>
<tr>
<td><strong>Knowledge constraints (α = .867; CR = .870; AVE = .630)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) My firm is limited in staff that is needed to accomplish our innovation objectives.</td>
<td>0.876</td>
</tr>
<tr>
<td>(2) My firm is limited in staff that is needed to produce products or provide services.</td>
<td>0.942</td>
</tr>
<tr>
<td>(3) My firm is limited in technological knowledge that is needed to develop our products or services.</td>
<td>0.700</td>
</tr>
<tr>
<td>(4) My firm is limited in market knowledge that is needed to sell products or provide services into new markets.</td>
<td>0.614</td>
</tr>
<tr>
<td><strong>Financial constraints (α = .915; CR = .915; AVE = .844)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) My firm is limited in external capital needed to accomplish our innovation objectives.</td>
<td>0.923</td>
</tr>
<tr>
<td>(2) My firm is limited in internal capital needed to accomplish our innovation objectives.</td>
<td>0.914</td>
</tr>
<tr>
<td><strong>Bricolage (α = .957; CR = .954; AVE = .725)</strong></td>
<td></td>
</tr>
<tr>
<td>(1) When we are facing new challenges we are confident in our ability to find workable solutions by using our existing resources.</td>
<td>0.903</td>
</tr>
</tbody>
</table>
(2) We willingly take on a broader set of challenges than our available resources allow us to do.  

(3) When responding to a new problem or opportunity, we use any existing resource that seems useful for this purpose.  

(4) We face new challenges by combining our existing resources with external resources that are available to us inexpensively.  

(5) When dealing with new problems or opportunities, we consider using the existing resources as a workable solution.  

(6) We take on a surprising variety of new challenges with the resources that we have.  

(7) When we face new challenges, we prefer to create solutions from our existing resources rather than acquiring new resources.  

(8) We combine resources to accomplish new challenges that the resources were not originally intended to accomplish.  

| Note.  \( \alpha \) = Cronbach’s \( \alpha \); \( \text{AVE} \) = average variance extracted; \( \text{CR} \) = composite reliability.  

Model fit statistics: \( \chi^2(155) = 308.801 \ (p < .001) \); \( \chi^2/\text{df}=1.99; \ CFI = 0.950; \ IFI = 0.951; \ TLI = 0.939; \ RMSEA = 0.074 \). All factor loadings are significant at the .01 level.  

| Common method bias and multicollinearity  

As with the first two essays, several procedures suggested by Podsakoff et al. (2003) were used to address the common method bias (CMV) and the one factor analysis (Harman, 1976) was run to detect the CMV issue. No common method bias was detected in this paper. The variance inflation factor for each independent variable was lower than the suggested threshold of 4, which suggests the absence of multicollinearity (Chatterjee & Hadi, 2015).  

| RESULTS  

Table 3.3 provides the means, standard deviations, and correlations. The sample firms have 37.93 employees on average, with a minimum 5 employees and maximum 145 employees. The firm age ranges from one year old to eight years old with a mean age of 5.32 years. The average revenue, measured as the revenue of the last physical year, was
between $1.5 million to 2 $million. The sample firms face relatively high industry competitiveness with a mean score of 3.31. The sample firms have moderate levels of resource constraints, with a mean score of 2.55 and 2.40 for knowledge constraints and financial constraints respectively. The mean value for divergent thinking is 2.33 and 2.92 for convergent thinking, indicating a relatively low level of both variables. The mean score for bricolage is 2.59, indicating a moderate level of bricolage in the sample firms. This number indicates that many firms in the sample do not engage in bricolage behaviors. A closer look of the sample shows that the industries with an average bricolage score of more than 3 include manufacturing, constructions, services, and retail trade, indicating most of the firms in these industries engage in bricolage. The other industries, i.e., agriculture, forestry and fishing, transportation and communications, wholesale trade, insurance, and real estate have an average bricolage score lower than 3, indicating most of the firms in these industries do not engage in bricolage. Finally, the mean score for innovation is 5.97.

Table 3.3: Means, Standard Deviations, and Correlations

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Firm size</td>
<td>37.93</td>
<td>22.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Firm age</td>
<td>5.32</td>
<td>2.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Revenue</td>
<td>4.12</td>
<td>1.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Divergent thinking</td>
<td>2.33</td>
<td>0.98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Convergent thinking</td>
<td>2.92</td>
<td>1.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Knowledge constraints</td>
<td>2.55</td>
<td>0.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Financial constraints</td>
<td>2.40</td>
<td>1.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Bricolage</td>
<td>2.59</td>
<td>1.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: N = 183.
*p < .05. **p < .01
**Test of hypotheses**

In hypothesis 3.1, it was proposed that entrepreneurs’ divergent thinking will positively moderate the relationship between resource constraints and bricolage, such that the relationship will be stronger for entrepreneurs with high, as opposed to low, divergent thinking. As shown in model 3 of Table 3.4, the interaction of knowledge constraints with divergent thinking ($\beta = 0.220; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = 0.342; p<0.1$) are both significant for bricolage. The interaction terms accounted for significant incremental variance in bricolage over the variance that the controls and the main effects explained ($\Delta R^2=0.34, p<0.001$). Therefore, the results supported hypothesis 3.1. To determine the nature of the moderating effect, the interaction was plotted using Cohen et al. (2013) procedure of computing slopes one standard deviation above and below the means of the two variables. Figure 7 provides a clear illustration of the interactions by demonstrating the influence pattern. As shown, the positive relationship between knowledge constraints and bricolage is stronger for those with high, as opposed to low, divergent thinking. Similarly, the financial constraints and divergent thinking have the same influence pattern on bricolage. This lends further support to hypothesis 3.1.
Table 3.4: Results of Moderated Hierarchical Regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm age</td>
<td>0.054</td>
<td>-0.069</td>
<td>-0.075</td>
</tr>
<tr>
<td>Firm size</td>
<td>0.012</td>
<td>0.024</td>
<td>0.013</td>
</tr>
<tr>
<td>Revenue</td>
<td>-0.022</td>
<td>-0.013</td>
<td>-0.006</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge constraints</td>
<td></td>
<td>0.286***</td>
<td>0.367***</td>
</tr>
<tr>
<td>Financial constraints</td>
<td></td>
<td>0.464***</td>
<td>0.427***</td>
</tr>
<tr>
<td><strong>Interaction terms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge constraints * Divergent thinking</td>
<td></td>
<td>0.220***</td>
<td></td>
</tr>
<tr>
<td>Financial constraints* Divergent thinking</td>
<td></td>
<td>0.342**</td>
<td></td>
</tr>
<tr>
<td>Knowledge constraints* Convergent thinking</td>
<td></td>
<td>-0.240***</td>
<td></td>
</tr>
<tr>
<td>Financial constraints * Convergent thinking</td>
<td></td>
<td>-0.013**</td>
<td></td>
</tr>
</tbody>
</table>

F                           0.155   29.031   18.087  
R^2                          0.003   0.451   0.485   
ΔR^2                         0.003   0.448   0.034   

Dependent variable: Bricolage
* p < .05; ** p < .01; *** p < .001

In hypothesis 3.2, it was proposed that entrepreneurs’ convergent thinking will negatively moderate the relationship between resource constraints and bricolage, such that the relationship will be weaker for entrepreneurs with high, as opposed to low, convergent thinking. As shown in model 3 of Table 3.4, the interaction of knowledge constraints with convergent thinking (β = -0.240; p<0.001) and the interaction of financial constraints with divergent thinking (β = -0.103; p<0.01) are both significant for bricolage. The interaction terms accounted for significant incremental variance in bricolage over the variance that the controls and the main effects explained (ΔR^2=0.34, p<0.001). Therefore, the results supported hypothesis 3.2. To further verify the existence of the moderating effect, I plotted the interaction using Cohen et al. (2013) procedure of computing slopes one standard deviation above and below the means of the two variables. As shown in Figure 8, the positive relationship between knowledge constraints and bricolage is weaker...
for those with high, as opposed to low, convergent thinking. In fact, no relationship appears to exist between knowledge constraints and bricolage for those with high divergent thinking. Similarly, financial constraints and convergent thinking have the same influence pattern on bricolage. This result further supported hypothesis 3.2.

**Figure 7: Moderating Effect of Divergent Thinking on the Relationship between Knowledge Constraints and Bricolage**

Note: The moderation figure for financial constraints follows the same pattern as the above.
Figure 8: Moderating Effect of Convergent Thinking on the Relationship between Knowledge Constraints and Bricolage

Note: The moderation figure for financial constraints follows the same pattern as the above.

Robustness checks

To further verify the results and to rule out any alternative explanations, I split the whole sample into several subsamples by firm age, size, and industry and then I ran the same analysis to see if the results still hold. First of all, I excluded the firms that do not have ten firms in an industry, thus giving me a new sample of 170 firms. The data analysis for this new sample shows that the results for all the hypotheses still hold. For hypothesis 3.1, the interaction of knowledge constraints with divergent thinking ($\beta = 0.312; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = 0.186; p<0.1$) are both significant for bricolage. For hypothesis 3.2, the interaction of knowledge constraints with convergent thinking ($\beta = -0.326; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = -0.257; p<0.01$) are both significant for bricolage.
I then split the sample into two sub-samples by the firm size. One sub-sample includes 82 firms with less than 30 employees (including 30). The other sub-sample includes 101 firms with more than 30 employees. I ran the same analysis for these two sub-samples. For the first sub-sample, the results hold. For hypothesis 3.1, the interaction of knowledge constraints with divergent thinking ($\beta = 0.412; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = 0.261; p<0.1$) are both significant for bricolage. For hypothesis 3.2, the interaction of knowledge constraints with convergent thinking ($\beta = -0.226; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = -0.277; p<0.01$) are both significant for bricolage. For the second sub-sample, the results also hold. For hypothesis 3.1, the interaction of knowledge constraints with divergent thinking ($\beta = 0.314; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = 0.254; p<0.1$) are both significant for bricolage. For hypothesis 3.2, the interaction of knowledge constraints with convergent thinking ($\beta = -0.306; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = -0.248; p<0.01$) are both significant for bricolage.

Finally, I split the sample by their revenue. I got the first sub-sample with 75 firms with lower than 1.5 million annual revenues. The second sub-sample includes 72 firms with more than 2 million annual revenues. Again, I ran the same analysis for these two sub-samples. For the first sub-sample, the results hold. For hypothesis 3.1, the interaction of knowledge constraints with divergent thinking ($\beta = 0.412; p<0.001$) and the interaction of financial constraints with divergent thinking ($\beta = 0.261; p<0.1$) are both significant for bricolage. For hypothesis 3.2, the interaction of knowledge constraints with convergent thinking ($\beta = -0.226; p<0.001$) and the interaction of financial constraints with divergent thinking
thinking ($\beta = -0.277; p < 0.01$) are both significant for bricolage. For the second sub-sample, the results still hold. For hypothesis 3.1, the interaction of knowledge constraints with divergent thinking ($\beta = 0.382; p < 0.001$) and the interaction of financial constraints with divergent thinking ($\beta = 0.303; p < 0.1$) are both significant for bricolage. For hypothesis 3.2, the interaction of knowledge constraints with convergent thinking ($\beta = -0.306; p < 0.001$) and the interaction of financial constraints with divergent thinking ($\beta = -0.315; p < 0.01$) are both significant for bricolage.

The robustness checks suggest that the results in this paper have a high level of validity.

**DISCUSSION**

Bricolage is a behavior that individuals, such as firms’ owners, CEOs, or managers, execute (Baker & Nelson, 2005). Therefore, individual-level factors are important for understanding why entrepreneurs engage in bricolage behaviors. In particular, creativity might influence bricolage because bricolage inherently involves combining resources in creative ways (Baker & Nelson, 2005). In this paper, I examined the moderating role of creativity cognitive thinking in the relationship between resource constraints and bricolage. As predicted, divergent thinking has a positive moderating effect in the relationship between resource constraints and bricolage, whereas convergent thinking has a negative moderating effect in this relationship. These findings confirmed that different cognitive styles may lead to different perceptions and behavioral tendencies when entrepreneurs face penurious environments (Chen et al., 2015). The finding about the positive moderating role of divergent thinking suggests that creativity does enhance bricolage in the resource-constrained context. Given the resource-constrained context,
entrepreneurs with higher levels of divergent thinking are more likely to engage in bricolage behavior.

Divergent thinking, the process of generating many and different ideas, is an important aspect of individual creativity in organizations (Williams, 2004). Divergent thinking often leads to originality, which is the central feature of creativity (Runco & Acar, 2012). Effective creative problem-solving requires the generation of varied and diverging potential solutions (Ford, 1996), and divergent thinking helps individuals to identify problems and creative ways of implementing solutions with their richness of imagination and non-linear thought (Basadur & Hausdorf, 1996). This attribute is corresponding with the inherent feature of bricolage in that bricolage requires bricoleur to recombine resources in ways they were not originally designed. Therefore, divergent thinking may enable entrepreneurs to make do with the existing resources at hand in creative ways. The finding further enriches our understanding of what factors drive or enhance bricolage behavior. This is important because bricolage has been found to have a positive impact on many firm-level outcomes (Desa, 2012; Senyard et al., 2014; Stenholm & Renko, 2016). Therefore, unraveling what factors interact with the antecedents of bricolage to enhance bricolage behaviors has important theoretical as well as practical meanings.

Convergent thinking was found to have negative moderating effect in the relationship between resource constraints and bricolage. This indicates that given the resource-constrained context, entrepreneurs with higher levels of convergent thinking are less likely to engage in bricolage behavior. People with convergent thinking tend to come up with definite answer to a question. They are more likely to solve problems based on logic and linear thought (Armstrong et al., 2012; Cropley, 2006). This might not be consistent
with the features of bricolage, which involves recombining resources in different ways. When engaging in bricolage, no definite answer exists for how to make do with resources. There might be different ways of recombination, which requires entrepreneurs to have non-linear thought. However, convergent thinking may result in “single best answer” rather than various ways of resource recombination.

**IMPLICATIONS FOR THEORY**

First, this paper contributes to the emerging literature that explores the antecedents of bricolage by investigating how creativity cognitive style interacts with resource constraints to influence bricolage (Desa & Basu, 2013; Stenholm & Renko, 2016; Welter & Xheneti, 2013). The findings of this paper advance the theory of entrepreneurial bricolage by identifying individual-level moderators in the relationship between resource constraints and bricolage. The findings of this essay help us to draw a more complete picture of factors that drive bricolage behavior in the resource-constrained environment. It opens a door for future research to investigate other potential antecedents of bricolage. This study also sheds light on the relationship between creativity and bricolage. In the literature, bricolage is identified as a facilitator of creativity climate (e.g., Baker & Nelson, 2005). In this study, however, it was found that creativity can promote the engagement of bricolage in the resource-constrained context. It would be an interesting topic for future research to study the causal direction between bricolage and creativity.

**IMPLICATIONS FOR PRACTICE**

The finding of this paper has important implications for practice. First, if firms want to promote bricolage behaviors, they can consider hiring managers or CEOs with high levels of divergent thinking. In this way, firms will be more likely to engage in bricolage
under the resource constraints. Second, divergent thinking ability could be taught (Cropley, 2006). For firms that aim to promote bricolage behaviors, they may provide training to their current managers or CEOs to improve their divergent thinking ability. This is not saying that convergent thinking has a lower value than divergent thinking. Divergent thinking is actually a very important trait for top management people (Simonton, 2015). However, when speaking of bricolage, divergent thinking is more likely to facilitate such behavior than convergent thinking does.

LIMITATIONS AND FUTURE RESEARCH

This study had three main limitations that need to be addressed and may provide future research opportunities. First, I adopted subject measures to measure the resource constraints variables. Although this measurement has adequate reliability and some scholars also use it to measure resource constraints variables (e.g., Keupp & Gassmann, 2013), it may not be able to capture the objective resource status of a firm. As stated, the respondents were asked to rate their perceptions about the degree of resources constraints. Although entrepreneurs are the most appropriate informants about the statuses of their firms’ resources, their subjective perceptions may not be that accurate. Future research may consider developing a new measurement to measure resource constraints. Or one can combine subjective and objective measurements to validate the resource status of a firm.

Second, a single informant completed the survey. This was acceptable because the managers or the owners of a company are familiar with the information related with each question in the survey. However, this may cause common method variance to the results. I took actions to minimize this issue, such as assuring the respondents that there were no
absolutely right or wrong answers in the survey and informing the respondents that they could withdraw the survey anytime. To further check the common method variance, I performed Harman (1976) one-factor test and found that the common method variance was not a serious concern in this paper. Nevertheless, future research should consider inviting multiple informants to answer the survey to minimize the common method bias.

Third, the cross-sectional design may not capture the causal relationship between independent variables and dependent variables. Longitudinal design is encouraged in the future research to verify the casual links between divergent thinking and bricolage.

CONCLUSION

In this study, I examined the moderating role of entrepreneurs’ creative thinking styles, namely divergent thinking and convergent thinking, in the relationship between resource constraints and bricolage. Drawing on survey data from 183 entrepreneurs, I found that divergent thinking has a positive moderating effect in the relationship between resource constraints and bricolage and convergent thinking has a negative moderating effect in this relationship. The findings of this paper contribute to the entrepreneurial bricolage theory by identifying the positive moderating role of divergent thinking in engaging bricolage in the context of resource scarcity. This is one of the first papers done in an attempt to link resource constraints, divergent thinking, and bricolage. The findings indicated that entrepreneurs who have higher divergent thinking levels are more likely to engage in bricolage behaviors given the context of resource constraints. Entrepreneurs with higher levels of convergent thinking, however, are less likely to engage in such behavior in the resource-constrained context.

What follow next is the overall concluding remarks for this dissertation.
OVERALL CONCLUSION

In this dissertation, I begin with three goals. First, I seek to extend the bricolage-innovation link. Second, I aim to explore the influence of bricolage on EO. Third, I seek to assess how individual-level factors affect bricolage given the resource-constrained environment. To realize these goals, I conducted three studies that led to three essays. In the first study, based on the literature that connects bricolage and innovation and the literature that links resource constraints and innovation, I explored the influence of knowledge constraints and financial constraints on innovation through bricolage. I found that bricolage fully mediates the relationship between knowledge constraints and innovation but partially mediates the relationship between financial constraints and innovation. In the second study, I examined the influence of bricolage on the three sub-factors of EO—innovativeness, proactiveness, and risk-taking. I found that bricolage is positively related to innovativeness, whereas it is negatively related to risk-taking. Bricolage was found no effect on proactiveness. In the third study, I investigated the moderating effects of entrepreneurs’ creative thinking styles, namely divergent thinking and convergent thinking, in the relationship between resource constraints and bricolage. The results showed that divergent thinking has a positive moderating effect in the relationship between resource constraints and bricolage and convergent thinking has a negative moderating effect in this relationship.

The first essay contributes to the literature of bricolage and innovation as well as the literature of resource constraints and innovation by revealing the mediating role of bricolage in the relationship between knowledge constraints and innovation. To some extent, this finding helps to resolve the debate whether resources constraints can facilitate innovation and under what conditions (Gibbert et al., 2014). It also extends the bricolage-
innovation link by empirically testing the effect of two forms of resource constraints on innovation through bricolage. The second essay contributes to the EO literature and the theory of entrepreneurial bricolage by demonstrating that bricolage influences two components of EO: innovativeness and risk-taking. The third essay advances the theory of entrepreneurial bricolage by identifying individual-level moderators, i.e., creativity cognitive style, in the relationship between resource constraints and bricolage.

The findings of this dissertation have important implications for practice. First, the finding regarding the mediating role of bricolage in the relationship between knowledge constraints and innovation can inspire firms with limited knowledge resources to make do by recombining their existing knowledge in creative ways to realize innovation goals. In addition, firms do not necessarily have to seek external resources in order to achieve innovation goals. Instead, they could allow the existence of certain degree of resource constraints, which may trigger firms to be more creative and innovative. Second, the positive effect of bricolage on innovativeness orientation suggests that firms aiming to achieve innovative outcomes may consider engaging in bricolage behaviors to improve their innovativeness orientation. Third, the findings regarding the antecedents of bricolage can help firms in their hiring and training processes. If firms intend to engage in bricolage behaviors as an approach to achieve firm growth, they may want to hire managers with higher levels of divergent thinking.
REFERENCE


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APPENDIX: CONSTRUCT AND MEASUREMENT

Constructs, Items, and Sources

EO (Covin & Slevin, 1989)

**Innovativeness**

(1) We have a strong emphasis on R&D, technological leadership, and innovations
(2) Changes in product or service lines have usually been quite dramatic to achieve competitive advantage
(3) One of the main goals is to launch many new lines of products/services in next three years

**Proactiveness**

(1) We tend to be ahead of competitors regarding introduction of products and ideas
(2) We typically initiate actions which competitors then respond to
(3) We are often the first to introduce new products and services, new ways to produce these, or new administrative methods.

**Risk-taking**

(1) We see bold, wide-ranging acts are necessary to achieve the firm’s objectives
(2) We have a strong aptitude for high-risk projects (with chances of high returns)
(3) My firm typically adopts a bold posture when confronted with decisions involving uncertainty, to maximize the exploitation of opportunities

**Bricolage** (Senyard et al., 2014)

(3) When we are facing new challenges we are confident in our ability to find workable solutions by using our existing resources.

(4) We willingly take on a broader set of challenges than our available resources allow us to do.

(5) When responding to a new problem or opportunity, we use any existing resource that seems useful for this purpose.

(6) We face new challenges by combining our existing resources with external resources that are available to us inexpensively.

(7) When dealing with new problems or opportunities, we consider using the existing resources as a workable solution.

(8) We take on a surprising variety of new challenges with the resources that we have.

(9) When we face new challenges, we prefer to create solutions from our existing resources rather than acquiring new resources.

(10) We combine resources to accomplish new challenges that the resources were not originally intended to accomplish.

**Parallel bricolage**
(1) We deal with problems or opportunities by using existing resources in all the activities in our firm.
(2) We make do with our existing resources to new problems and opportunities and keep doing this after the problems are solved or the opportunities are realized.
(3) We consider our ability to make do with our existing resources in all the activities in our firm as a positive identity.

**Selective bricolage**
(1) We deal with problems or opportunities by using our existing resources in one or a few aspects of firm’s operation.
(2) Once the problems are solved or the opportunities are realized, we will reject the practice of making do by using our existing resources.
(3) We standardize the practice we learn in the process of making do with existing resources.

**Divergent thinking** (Basadur & Hausdorf, 1996; Cropley, 2006)
(1) I enjoy stretching my imagination to produce many ideas.
(2) I easily come out unique ideas.
(3) I favor to look at thing from a non-traditional view.

**Convergent thinking** (Basadur & Hausdorf, 1996; Cropley, 2006)
(1) I like to take the time to clarify the problem.
(2) I like to identify the data and fact related to the problem.
(3) I like to focus on the precise description of the problem.

**Knowledge constraints** (Keupp & Gassmann, 2013)
(1) My firm is missing R&D staff that is needed to accomplish our innovation objectives
(2) My firm is missing production staff that is needed to produce our products
(3) My firm is missing technological knowledge that is needed to develop our products
(4) My firm is missing market knowledge that is needed to sell products into new markets

**Financial constraints** (Keupp & Gassmann, 2013)
(1) My firm is missing the external financial means to accomplish our innovation objectives
(2) My firm is missing the internal financial means to accomplish our innovation objectives

**Firm innovation** (Kochhar & David, 1996)
The number of new products, services, processes, and technologies developed by the firm

**Control variables**

**Firm size**
How many employees does your company have?
**Firm age**
How long have you owned or operated this business?

**Firm revenue**
What’s the revenue of your business in last fiscal year?

**Industrial types**
Please select the industry type that best describes your business

- Agriculture, Forestry and Fishing
- Mining
- Construction
- Manufacturing
- Transportation, Communications, Electric, Gas and Sanitary service
- Wholesale Trade
- Retail Trade
- Finance, Insurance and Real Estate
- Services
- Public Administration
- Non-classifiable

**Industrial characteristics**

How would you describe the competitiveness of your industry from “not competitive”, “limited competitive”, “moderately competitive”, “very competitive”, and “extremely competitive”? 

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