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Microfoundations of dynamics capabilities: a lab experiment on cognitive processing and routine adaptation

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RIBEIRÃO PRETO
2019

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Furthermore, I feel compelled to position in broader terms my 4-year journey into the PhD. First, considering the current threats to science in Brazil and the limited resources that the country has to invest in research, I owe some accountability. During my PhD, I contribute at least with the following:

- 12 peer-reviewed publications, including top journals in the field;
- 6 academic awards;
- 2 research reports published;
- 4 book chapters published;
- 35 papers presented in conferences;
- 37 papers reviewed in service for journals and conferences;

I recognize that research requires long-term dedication and these numbers do not capture either the ongoing projects with faculty members or many of my activities in the university, but they do provide to society a glimpse of my efforts.

Second, I am a proud black gay man getting a PhD. The scars of slavery still echo in this country. Taking into account the violence that black and non-heterosexual populations still suffer in Brazil, I am here in a place that does not belong to me accordingly to a large part of Brazilian society. Thanks to everyone who has paved the way for me! While I am a first-generation PhD, I will certainly not be the last.

ABSTRACT

Alves, M. F. R. (2019). *Microfoundations of dynamics capabilities: a lab experiment on cognitive processing and routine adaptation* (PhD Thesis). School of Economics, Business Administration and Accounting of Ribeirão Preto, University of Sao Paulo, Ribeirao Preto.

Dynamic capabilities have been recognized as the key explanation of firm heterogeneity and a potential source of sustainable competitive advantage. However, a few empirical previous studies connected dynamic capabilities to individual action, nor do they take the opportunity to investigate cognitive processes underlying capability deployment. A central issue here is the emphasis only on the effects and the antecedents of dynamic capabilities, so existing research does not shed light on what are the lower-level elements that constitute a capability—its microfoundations. To fill this gap, we conducted a lab experiment with executives where we examine the effect of priming intuitive and reflective cognitive processing on routine adaptation after an exogenous shock. We provide evidence that teams under the intuition condition cope better with environmental changes than the ones under the reflection condition. We also found evidence that environments with more feedback-learning opportunities (i.e. more stable) facilitate routine adaptation. Further, we show that the payoffs for intuition rather than reflection are higher in environments with less feedback opportunities. These findings redirect the current understanding of intuitive thinking in organizational change. In sum, our study contributes to providing a micro-level account of firms' dynamic capabilities.

Keywords: Dynamic capabilities. Organizational routines. Experimental design. Cognition. Dual-process theory.

RESUMO

Alves, M. F. R. (2019). *Microfundamentos das capacidades dinâmicas: um experimento de laboratório sobre processamento cognitivo e adaptação de rotina* (Tese de Doutorado). Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto.

As capacidades dinâmicas têm sido reconhecidas como a principal explicação da heterogeneidade da firma e uma potencial fonte de vantagem competitiva sustentável. No entanto, poucos estudos empíricos anteriores conectaram capacidades dinâmicas à ação individual, nem aproveitam a oportunidade para investigar os processos cognitivos subjacentes ao uso de capacidades. Uma questão central aqui é a ênfase apenas nos efeitos e nos antecedentes das capacidades dinâmicas, de modo que a pesquisa existente não esclarece quais são os elementos de nível inferior que constituem uma capacidade—seus microfundamentos. Para preencher essa lacuna, realizamos um experimento de laboratório com executivos, onde examinamos o efeito de induzir o processamento cognitivo intuitivo e reflexivo na adaptação de rotina após um choque exógeno. Fornecemos evidências de que as equipes sob a condição de intuição lidam melhor com as mudanças ambientais do que aquelas sob a condição de reflexão. Também encontramos evidências de que ambientes com mais oportunidades de feedback para aprendizado (ou seja, mais estáveis) facilitam a adaptação de rotina. Além disso, mostramos que o retorno por intuição e não por reflexão são mais altos em ambientes com menos oportunidades de feedback. Estes resultados redirecionam o entendimento do pensamento intuitivo na mudança organizacional. Em suma, nosso estudo contribui para fornecer uma explicação em nível micro das capacidades dinâmicas das empresas.

Palavras-chave: Capacidades dinâmicas. Rotinas organizacionais. Desenho experimental. Tomada de decisão. Teoria de processamento duplo.

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1. INTRODUCTION

1.1 The microfoundations movement

Which level of analysis can better inform practitioners and scholars on organizational phenomena? The notion of microfoundations born from the tension whether individual and collective outcomes should focus on the individual or collective level explanations (Felin, Foss, & Ployhart, 2015). Whereas history, culture, and structure are the focus in the perspective of the macro explanations, in the micro other elements are highlighted such as individual actions and interactions.

Varieties of this debate exist since at least the 20th century as the one between the German Historicist School and the Austrian School of Economics. The study of organizations, as social sciences in general, followed the sociologic notion of Durkheim (1982, p. 106) that "individual natures are merely the indeterminate material that the social factor molds and transforms". While this notion of the macro perspective does not seem realistic, strategic management and organizational theory followed this path (Felin et al., 2015). In this sense, the organizational theory has been usually direct to the environment rather than individual action or even to organizations (King, Felin, & Whetten, 2010).

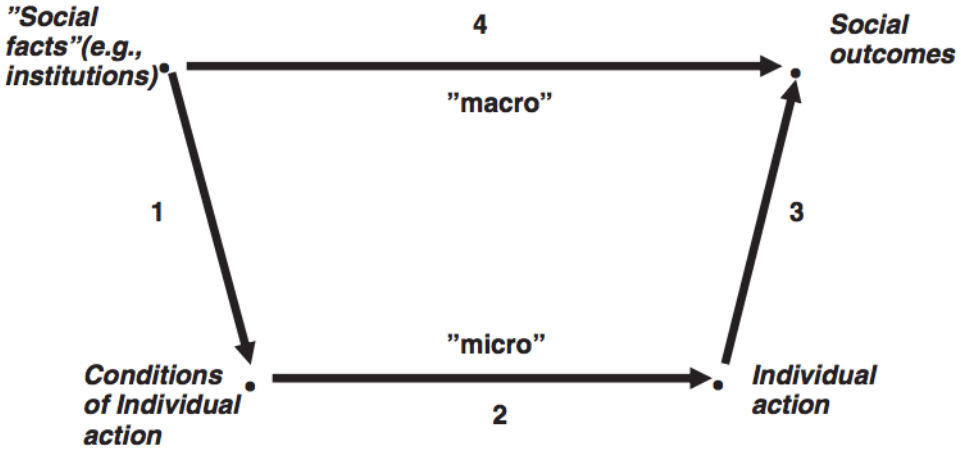
Against this notion, more and more academics have argued that studies should go beyond correlations among abstract collective-level variables because individual action and interaction are the key explanations of organizational phenomena (e.g. Abell, Felin, & Foss, 2008; Salvato & Rerup, 2011). According to Coleman (1990), the most recognized work of this line of argumentation, any macro-level phenomena (e.g. capabilities, routines, organizations) can, and should be, explicated in terms of lower-level variables.

This idea is at the heart of the microfoundations, defined by Felin, Foss, Heimeriks, and Madsen (2012, p. 1355) as a "...theoretical explanation, supported by empirical examination, of a phenomenon located at analytical level N at time t (N_t). In the simplest sense, a baseline microfoundation for level N_t lies at level N-1 at time t-1, where the time dimension reflects a temporal ordering of relationships with

phenomena at level N-1 predating phenomena at level N. Constituent actors, processes, and/or structures, at level $N\text{-}1_{t\text{-}1}$ may interact, or operate alone, to influence phenomena at level N_t. Moreover, actors, processes, and/or structures at level $N\text{-}1_{t\text{-}1}$ also may moderate or mediate influences of phenomena located at level N_t or at higher levels (e.g., $N+1_{t+1}$ to $N+n_{t+n}$)."

Coleman's (1990) "bathtub" (**Figure 1**) offers an illustrative representation of macro-level and micro-level research. Research following causal mechanisms such as arrow 3, arrows 3-2 or arrows 3-2-1 incorporates progressively a bigger emphasis on the microfoundations. However, most of the research in strategic follows arrow 4, placing the challenge for future research to unpack these macro-level phenomena. Also, **Figure 1** describes another two dimensions to be considered in the investigation of the microfoundations: one in the vertical direction (N-1) and the other in the horizontal direction (t-1).

Figure 1 – A general model of social science explanation



Source: Coleman (1990)

In order to provide an example for this conceptual discussion, Felin et al., (2012) provided a framework for research on the microfoundations organizational routines and capabilities (the focus of this study). They suggest three buildings blocks: individuals, processes, and structures. Work on individuals comprises their behavioral and psychological underpinnings and also their characteristics and abilities. Processes are mainly informed by methods of coordination and integration and by technology and ecology. Finally, the study of the structure includes a body

of work on the design of decision-making activities. The next section discusses the research approach of this study for the microfoundations of dynamic capabilities following the individuals' behavioral and psychological traits.

1.2 Research approach

The research on dynamic capabilities followed a path towards a more granular level of analysis, which can be depicted from the main definitions of dynamic capabilities, for example (Helfat et al., 2007). The seminal definition of Teece, Pisano, & Shuen (1997, p. 516) focuses on the enterprise level of analysis (i.e. "the firm's ability") such as the creation of new paths to the firm. Next, Eisenhardt and Martin (2000, p. 1107) offer a more refined definition based on the processes level (i.e. "The firm's processes") as new product development or resource allocation. Later, Zollo and Winter (2002, p. 340) go further and stress the routines level of analysis (i.e. "a learned and stable pattern of collective activity").

A similar scenario is found in empirical studies from environmental fitness to how a capability is constructed (Di Stefano, Peteraf, & Verona, 2010). First, studies were mainly concerned with firm adaptation to environmental changes (e.g. Lampel & Shamsie, 2003). Then, they become more attracted to how internal processes shape the firm's resource base, such as R&D and marketing capabilities (Danneels, 2008). Finally, the latest works started to understand behavioral patterns and agency in capability emergence (Laureiro-Martínez, Brusoni, Canessa, & Zollo, 2015).

Recently, Wilden et al., (2016) developed a research roadmap of dynamic capabilities research (**Table 1**):

Table 1 – The evolution of dynamic capability themes

Past themes	Persistent themes	Emerging themes
Alliancing	Learning	Cognitive processes
Competitive Advantage	Resources	Microfoundations
Technology	Performance	Enablers of dynamic capabilities
Ambidexterity	Routines	Market creation

Source: Adapted from Wilden et al., (2016).

Table 1 reiterates the shift towards lower levels of analysis, namely, the role of cognitive processes and micro-foundations of dynamic capabilities as underpinnings (the focus of this study). Also, it shed light on market creation, while most of the research emphasizes firm adaptation (market-driven), dynamic capabilities may support more active strategic conduct (market-driving). Other themes, once relevant in the early formulation of dynamic capabilities theory, are now peripheral. Except for ambidexterity which was integrated into routines, they seem to share in common the focus beyond or across the borders of the firm.

Therefore, the future research path should look inside the firm, as the evolution of the dynamic capabilities concept lead to the current stage where the literature started to address individual or micro-foundational levels of analyses such as managerial choice (Zahra, Sapienza, & Davidsson, 2006), top management skills (Teece, 2012), dynamic managerial capabilities (Kor & Mesko, 2013), and managerial cognitive capabilities (Helfat & Peteraf, 2015).

The dynamic capabilities framework have received increased interest from scholars as reflected mainly by the strategic management literature (Schilke, 2014; Vergne & Durand, 2011; Zollo & Winter, 2002) and also other fields such as international business (Salvini & Galina, 2015), sustainable development (Amui, Jabbour, Jabbour, & Kannan, 2017; Cezarino, Alves, Caldana, & Liboni, 2019) and business processes management (Bernardo, Galina, & Pádua, 2017). The main assumption underlying this body of knowledge is that capabilities are key explanatory variables to understand heterogeneity in organizational behavior and the resultant outcomes.

But how organizations can develop dynamic capabilities? To the date, the answer is of foremost interest for theory and practice. Beyond the effect of variables external to the firm such as market dynamism (e.g. Wang & Ahmed, 2007), the main explanation rely on the organization itself creating, extending or modifying the operational capabilities in order to address the changes in the competitive environment (Eisenhardt & Martin, 2000; Teece et al., 1997; Zollo & Winter, 2002).

This kind of explanation relies on macro-level correlations of constructs that are abstract and hard to translate into normative strategies (Felin et al., 2015). As suggested by Pisano (2016), a framework of strategic management that cannot provide guidelines for strategy does not belong to strategic management. In line with this line of inquiry, the literature has increasingly acknowledged rooting collective organizational concepts such as routines and capabilities in individual action and interaction: the microfoundations (Abell et al., 2008).

The traditional approach in strategic management, for instance, examines the surface of the effect between macro-level constructs, such as the impact of organizational capabilities on performance. The microfoundation approach argues that under this phenomenon, individuals operate to build that abstract capability (Abell et al., 2008; Felin et al., 2015). Once the literature reveals how individuals' actions generate dynamic capabilities, the field can move towards more precise conceptual definitions and practical implications (Felin et al., 2015). However, there still a few empirical studies following this approach (Felin et al., 2015).

Teece et al. (1997) and (Teece, 2007) gave conceptual explanations of human behavior involved in the processes of sensing and shaping, seizing and reconfiguring, mostly in the domain of the classical behavioral decision theory (March & Simon, 1958; Tversky & Kahneman, 1974). As pointed out by Hodgkinson and Healey (2011), this work neglected sequential developments in this area as the interaction between reflexive (e.g., intuition, implicit association) and reflective (e.g., explicit reasoning) cognitive capabilities in sensing and shaping opportunities, for instance.

In an attempt to contribute to close this gap, this research examines the effects of cognitive processing modes on dynamic capabilities—the firm ability to adjust their routines to cope with an exogenous shock (Zollo & Winter, 2002). Supported by the dual-process theory of reasoning, we depart from the fact that the use of intuitive (fast and affective) or reflective (slow and analytic) cognitive processing

affects group behavior (Peysakhovich & Rand, 2016). Intuitive thinking comprises less deliberative cognitive processes, such as affect and emotion (Akinci & Sadler-Smith, 2012; Sinclair, 2014). Rather than underscore an opposition between reason and emotion, this research follows the contemporary understanding that affect and emotion are integral to cognition (Healey & Hodgkinson, 2017). Due to specific characteristics of intuitive thinking, which will be discussed later, this study argues that intuitive thinking can represent an advantage over reflective thinking for dynamic capabilities. Accordingly, by taking advantage of a lab experiment with executives, we answer the following question:

- How cognitive processing modes affect dynamic capabilities?

To answer this question, this study relies on the behavioral strategy literature (Gavetti, Greve, Levinthal, & Ocasio, 2012; Liu, Vlaev, Fang, Denrell, & Chater, 2017). This tradition emphasizes the psychological foundations of the cognitive processes and the role of the social norms, incentives, commitments and affects (Liu et al., 2017). Specifically, this study follows the dual-process theory of reasoning to inform the main hypothesis (Evans, 2008).

1.3 Contributions of the study

This study potentially offers a number of contributions. First, this approach for study the microfoundations of dynamic capabilities contributes to the literature because it recognizes that capabilities are “fine-grained, and multilayered [in] nature” (Salvato & Rerup, 2011, p. 469). Whereas the traditional wisdom of the evolutionary perspective of capabilities (and organizational routines) treat them as massive units, this study recognizes the individual role in the collective nature of capabilities.

Second, this study explores a dimension of cognition (intuition) virtually not addressed in dynamic capabilities literature (Hodgkinson & Healey, 2011). Some exceptions of decision-making and affective cognition in strategic management literature are the studies of Di Stefano, King and Verona (2015) on retributive instincts, Håkonsson et al. (2016) on positive and negative emotions and Laureiro-Martínez, Brusoni, Canessa and Zollo (2015) on emotional control.

Third, this study sheds light on the behavioral microfoundations of dynamic capabilities. For example, Wilden, Devinney, and Dowling (2016) conduct a broad study including text analysis, a survey and roundtables with main authors in dynamic capabilities and the results suggest that cognitive processes and microfoundations are core emerging themes, unlike alliances or absorptive capacity. Moreover, Arndt, Pierce, & Teece (2017) highlight the importance of merge the evolutionary and behavioral perspectives in dynamic capabilities future development.

Finally, by employing an experimental method this study attend recent calls of the literature for causal evidence (Felin et al., 2015; Salvato & Rerup, 2011; Wilden et al., 2016), therefore, it helps to rebalance the empirical evidence in the literature focused on surveys and case studies. In sum, the empirical evidence of this study potentially will help to shape management practices to enhance dynamic capabilities development, an important progress in the field. As suggested by Arend and Bromiley (2009), despite the overall attention of the scientific community to the dynamic capabilities framework, limited findings have been translated into relevant information for practitioners.

1.4 Study organization

This first chapter (Introduction) positioned the phenomena under investigation in the literature and also outlined the goal of the study. Next, the second chapter (Theory) of the thesis provides the theoretical argument. Then, the third chapter (Method) explains how the hypotheses of the study were tested. The fourth chapter (Findings) outlines the results of the empirical investigation. The fifth chapter (Discussion) informs the implications, limitations and future studies. The last chapter (Conclusion) ends the thesis with the final remarks.

2. THEORY

This chapter has four parts. The first one places the study of individual cognition in organizations by means of the behavioral tradition (micro-level research in strategy). The second part conceptualize dynamic capabilities adopting organizational routines as their building blocks (macro-level research in strategy). The third contends an approximation between micro (cognition) and macro (dynamic capabilities). And finally, the last part of the chapter introduces the research framework and the hypotheses of the thesis.

2.1 Micro-level: Cognition in Organizations

2.1.1 Carnegie School: the birth of the Behavioral Theory of the Firm1

Three books are at the foundation of organizational behavior research: "Administrative Behavior" (Simon, 1947), "Organizations" (March & Simon, 1958) and "A Behavioral Theory of the Firm" (Cyert & March, 1963). Because James March, Herbert Simon, and Richard Cyert were professors at the then Carnegie Institute of Technology (USA), this approach became known as the Carnegie School (Augier, 2013). Before their studies, research on organizations almost did not pay attention to decision-making in general, with a particular lack of concern about the decision-making process (Gavetti et al., 2012). So, how fundamental decisions such as price and resource allocation are taken in organizations? There was no explanation at that time. Considering that, the main objective of the behavioral theory of the firm is to explain the reality of the decision-making process (and their outcomes).

They developed a school of thought based on the notion that (1) organizations are the focus of study, (2) decision-making is the leading channel to examine them and (3) behavioral plausibility is the basic premise of this school (Gavetti, Levinthal, &

[1] Although this tradition of research is close with psychology studies, do not confuse with the behavioral psychology (Skinner, 1953). The word behavioral here intended to claim realistic assumptions on human actions in management and organization studies.

Ocasio, 2007). The logic behind the research program came as a critique of the conventional approach on market-level focus and aggregate outcomes explanations (rather than process), for example, firm profit is given by industry return – a function of supply and demand. Accordingly, "there are a number of interesting questions relating specifically to firm behavior that the theory cannot answer and was not developed to answer, especially with regard to the internal allocation of resources and the process of setting prices and outputs" (Cyert & March, 1963, p. 16). Even in that time, these critiques of conventional studies of the firm were not exactly new, but their answer was: a theory developed to explain aggregate outcomes cannot enlighten process and micro-level phenomena (Gavetti et al., 2012).

Simon, Cyert and March developed the Carnegie School's cognitive foundations in a frontal assault to the assumptions of the classical economic theory of the firm, more specific the idea of rational-agent – someone who chooses to perform the action with the optimal expected outcome for itself from among all feasible actions (Gavetti et al., 2012). For example, if decision-makers lack perfect knowledge and must search for information, they cannot cope with the maximization notion of the rational agent model. In order to develop a "feasible rationality" (later known as bounded rationality), their theory can be synthesized around three main core postulates: (i) search, (ii) satisficing and (iii) rules, standard operating procedures and status quo (Cyert & March, 1963).

"Search" interplays a key role in explaining choice processes because individuals search for information and alternatives choices. In this sense, search is an activity derived from the notion that decision-makers do not know all the alternatives and their related outcomes (Simon, 1947). Once a satisfactory alternative is found, the search stops. "Satisficing" refers to the idea that people do not maximize outcomes in their decisions, instead of that, they choose alternatives that are good enough, that is, satisfactory ones. What conditioning an alternative becoming satisfactory is subject to the aspiration level, which is mostly like to be related to historical factors (Cyert & March, 1963). Although Cyert and March (1963), as they admit, did not develop a refined concept of "expectation" incorporating developments from psychology, "expectation" is an important variable to explain when search stops and a given alternative became satisfactory. And the third element, "rules, standard operating procedures and status quo". Automatic rules (standard operating procedures) are coping mechanisms that save or reduce the need for searching for

information (i.e. planning procedures or forecasting exercises). They operate narrowing alternatives informed by the experience and because of that, they hardly violate the status quo (Cyert & March, 1963).

The power of these ideas could not create a behavioral theory of the firm (as the name of one of the books may suggest), but was the starting point of theory taking a bounded rationality view of decision making and organizational behavior (Argote & Greve, 2007). A variety of lines of inquiry takes elements developed by the Carnegie School of thought as premises, such as bounded rationality, problemistic search and standard operating procedures (organizational programs). However, two programs of research in organization studies are direct developments from the Carnegie School: organizational learning theory (Levitt & March, 1988) and evolutionary economics (Nelson & Winter, 1982). It is not by chance that they have become more integrated (Gavetti & Levinthal, 2004).

Organizational learning can be investigated in terms of intra-organizational learning, organizational learning, and inter-organizational learning (Baum, 2002). They share in common the focus on similar learning mechanisms, for example, diffusion and imitation of practices between and within organizations. Moreover, the same learning processes can be seen at multiple levels of analyses with multiple consequences as well. A persistent research theme of research examined by Cyert and March (1963) is the role of experience in organizational learning.

Evolutionary economics focuses on firm and industrial processes of evolution where this evolution is assumed to occur incrementally driven by search rather than radically driven optimization—as expected in rational-agents (Nelson & Winter, 1982). At the industrial level, this theory examines the implications of the behavioral assumptions for industrial evolution (Dosi, Nelson, & Winter, 2000). At the firm level, heterogeneity of routines and capability are at the center-stage (Zollo & Winter, 2002). In this theory, while routines and path dependence are understood as sources of stability, search processes promote changes (Nelson & Winter, 1982).

Beginning from an era of now-perceived stability, the early work of the Carnegie School (Cyert & March, 1963; March & Simon, 1958) emphasized behavioral bounds on managers' ability to coordinate and control complex organizational systems. Precisely, attention was often directed "toward the 'steady-state' rather than toward change in organizations" (March & Simon, 1993, p. 193). However, as be seen

by the focus on learning and evolution, change has become central in behavioral theory. Therefore, next, we discuss behavioral theory in the context of strategy.

2.1.2 Behavioral theory reaches Strategy

Why AOL/Time-Warner and HP/Compaq mergers failed? Why Lehman Brothers, Bear Stearns, and BP faced performance shocks? The answer is not monopoly rents, factor scarcity, or entrepreneurship which implies to say that the three pillars of strategic management theory (Bain, 1959; Penrose, 1959; Schumpeter, 1934a) are not enough to move the field forward (Powell, Lovallo, & Fox, 2011)[2]. Powell, Lovallo, & Fox, 2011 (p. 1371) suggest a new approach to help explain these questions:

> Behavioral strategy merges cognitive and social psychology with strategic management theory and practice. Behavioral strategy aims to bring realistic assumptions about human cognition, emotions, and social behavior to the strategic management of organizations and, thereby, to enrich strategy theory, empirical research, and real-world practice.

In the same line of the Carnegie School in its birth, the definition provided by Powell et al., (2011) emphasizes the critique of the traditional approaches: unrealistic theories that cannot explain central questions in organizations, such as pricing policies. For strategic management, the particular question of interest is firm heterogeneity—in terms of strategies, structures or performance—as well as heterogeneity persistence.

Rather than substituting the existing theories in strategy, behavioral strategy can build a fourth pillar. As observed by Denrell, Fang, and Winter (2003), strategy theories tend to stress market efficiency and equilibrium. This assumption leads to the idea that managers are unable to improve firm performance following systematic strategies because other firms would discover and erode its value (Peteraf, 1993). But managers make decisions not attributable to chance and these decisions indeed improve firm performance (Denrell, Fang & Winter, 2003). It is

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[2] Levinthal (2011) offers a stimulating argument on the question of realistic rationality, where he concludes 'the choice is not between whether we should act in a God-like manner or like mortals. We are mortals.' (Levinthal, 2011, p. 1521).

possible to credit the differences in performance to resource scarcity or immobility for example (Peteraf, 1993), but this explanation assumes that managers have complete information on the market and act on that.

Instead of that, decision-makers may be unwilling to imitate (Di Stefano, King, & Verona, 2014) or have disordered learning processes (Denrell & March, 2001). Better or worst decisions can also stem from emotions such as envy, prejudice, anger, hubris, and impulsivity (Elfenbein, 2007; Hodgkinson & Healey, 2011). This scenario is in line with Powell's (2004) argument that firms usually fail in capturing opportunities, solving problems and imitating imitable resources. As firms may not know the rules or may not follow them, there are rules that improve performance, or in other words, "there is money left on the table" (Winter et al, 2008, p. 1). In this sense, firm heterogeneity explanation needs to go beyond market barriers and incorporate human cognition, emotions, learning, social interactions, and institutions (Powell et al., 2011).

The type of decision that individuals face in strategic management is characterized as extremely complex problem-solving (Simon, 1987) where the lack the cognitive capacity makes them unable to take fully informed and unbiased decisions (Kahneman, Slovic, & Tversky, 1982). Similarly to decisions involved in architecture and design, usually there is no right answer to be found: there is a risk-taking decision highly dependent on the problem understanding (Drucker, 1993). Accordingly, these decisions are understood as judgmental decisions (Hodgkinson, Langan-Fox, & Sadler-Smith, 2008; Kahneman & Klein, 2009).

Behavioral strategy comprehends a diversity of topics and it is far from achieving conceptual unity as can be seen in prior reviews (e.g. Eisenhardt & Zbaracki, 1992; Hodgkinson & Healey, 2008; Walsh, 1995). However, behavioral strategy represents an opportunity to overcome the limitations of the behavioral theory of organizations in dynamic environments (March & Simon, 1993). For example, more recent research on the behavioral microfoundations of strategy (Felin et al., 2015) and on the neo-Carnegie School (Gavetti et al., 2007) aligns closely with Schumpeterian view of the managerial function as one of introducing novelty and innovation into the organizational system to stimulate responsiveness and adaptation to dynamic environments (Gavetti, 2012; Levinthal & March, 1993; Teece, 2007).

Describing the weakness of traditional theories and how they do not have adherence to real-world conditions, set the stage for the most relevant contribution of behavioral strategy: improvement of decision making. Here, the literature is divided into two groups. The first one underscores individual cognitive errors, for example, individuals perform better when averaging between two options instead of choosing between them (Soll & Larrick, 2009). The second one underscores the context of choice managing the psychological architecture of the choice environment. That means to provide environmental 'nudges' supplemented by rewards and incentives, a strategy of intervention that seems to be more successful (Kahneman & Klein, 2009).

Next, Section 2.1.3 explores the last approach, which seems to be more promising. It is important to note that these two approaches are not exhaustive. For example, Denrell and March (2001) show that there are errors resultant from dysfunctional learning (biased limited set of experiences) and not limited cognition (known as 'hot stove effect').

2.1.3 The future: the architecture of choice

Instead of the traditional wisdom of deal with decision biases by means of changing the mind of the decision-maker (Bazerman & Moore, 2013), the architecture of choice takes the responsibility for organizing the context in which individuals make decisions (Thaler, Sunstein, & Balz, 2012). De-biasing strategies can be inefficient because they approach System 2 (the slow and conscious thinking processes) while System 1 (fast and automatic) is the main source of the biases (Marteau, Hollands, & Fletcher, 2012). An anecdotal example of unconscious bias is how the weather can influence the sentences given by judges (Danziger, Levav, & Avnaim-Pesso, 2011).

The strategic context is a new application to the architecture of choice, which has been primarily studied in the public policy area (Thaler et al., 2012). Today, this is a promising and growing approach to decision bias in strategy (Liu et al., 2017; Powell et al., 2011), however, there are limited strategic experimental research or even examples. **Table 2** presents nine contextual forces (Liu et al., 2017) where the architecture of choice can be applied, similar to a research agenda.

Table 2 – Framework for strategic architecture of choice

Contextual force	Behavior	Psychological Processes
Messenger	We are heavily influenced by who communicates information to us	Attraction; Trusting
Incentives	Our responses to incentives are shaped by predictable mental shortcuts such as strongly avoiding losses and mental accounts	Greed; Fear
Norms	We are strongly influenced by what others do	Belonging; Motor
Defaults	We "go with the flow" of pre-set options	Fear; Comfort
Salience	Our attention is drawn to what is novel and seems relevant to us	Mental
Priming	Our acts are often influenced by sub-conscious cues	Motor
Affect	Our emotional associations can powerfully shape our actions	Disgust; Fear; Attraction
Commitments	We seek to be consistent with our public promises and reciprocate acts	Status; Motor
Ego	We act in ways that make us feel better about ourselves	Status; self-worth

Source: Adapted from Liu et al., (2017, pp. 139–140).

Table 2 provides interesting indications for inquiry. For instance, in mergers and acquisitions, which failures are between 70% and 90%, firms could pre-commit (default) to discuss three similar deals that failed. Thus, reducing groupthink (norm), creating awareness of losses (incentive) and reducing the fear of stay behind other players (affect). Another example are the business meetings, where the message can be overweight or underweight because of the informant status (messenger). Meeting participants could deliver anonymous reports and one

person read them all or each participant read a random report. A similar effect can be achieved by anonymous voting in the meetings (norms) (Liu et al., 2017).
Another additional example, the 'salience' effect is frequently related to undervalued resources. Superior talented fall into the stereotype (salience) that the elite universities can provide the elite employees. Even if this notion is true to some extent, there are talented candidates with unattractive background consistent overlooked. Therefore, there is an opportunity for firms who do not hire only the stereotype of elite universities. The choice architecture can be addressed with a CV 'blind' policy, unveiling resources not notice by the competitors (Liu et al., 2017).

In the actual stage, the architecture of choice's proposal offers more a promise than a contribution. As stated by Powell et al., (2011), the real advance in behavioral strategy will come once in decision-making literature could inform strategic problems, such as resource heterogeneity. In the development of our hypotheses (Section 2.4), the underlying assumption is that firms might foster dynamic capabilities by improving the decision architecture based on our findings (more details on Section 5). Next, the second part of the literature review focuses on organizational routines and dynamic capabilities—macro-level concepts.

2.2 Macro-level: routines and capabilities

2.2.1 Understanding organizational routines[3]

Today, it is well accepted the notion that routines can be understood as repetitive and context-dependent patterns of interdependent organizational actions (Parmigiani & Howard-Grenville, 2011). Thus, routines are the daily actions that comprise a network of individuals and physical and non-artifacts interact to undertake a given task. They provide stability in organizational behavior but also adaptation to the environment and endogenous change as "routine operation is consistent with routinely occurring laxity, slippage, rule-breaking, defiance, and even sabotage" (Nelson & Winter, 1982, p. 108). Because of that, the stickiness of

[3] There are distinctions between the "capabilities" perspective and the "practice" perspective (Salvato & Rerup, 2011), but, in line with the research focus of this research on dynamic capabilities, the first one is emphasized.

them within firms are the explanation for firm environmental adaptation, and potentially for competitive advantage or disadvantage (Szulanski, 1996). One of the most accepted definitions is given by Feldman and Pentland (2003, p. 96) who conceptualize organizational routine as "a repetitive, recognizable pattern of interdependent actions, involving multiple actors."

As mention before, in Section 2.1, the notion of routines is derived from the Carnegie School (Cyert & March, 1963; March & Simon, 1958; Simon, 1947). In the early formulation of routines at that time, they comprehend them as standard procedures, rules, and patterns of behavior that support decision-making. Thus, routines were seen as 'bundles of decision rules' resembling habits and, thus, placing a secondary role in explaining heterogeneity performance against decision processes (Cohen, 2007). Only in 1982, routines become a central explanation of firm behavior and industry dynamics with Nelson and Winter's book "An Evolutionary Theory of Economic Change".

Nelson and Winter (1982) draw upon biology parallels to describe routines in organizations. According to them, routines are the genes of organizations, the elementary unity responsible for the characteristics that constitute a firm. The evolutionary change of organizations is explained by the routines because, like genes, they are heritable and subject to environmental selection. Another notion, particularly close to knowledge management, is that routines represent the memory of a firm: repositories of organizational memory, knowledge, and learning (Nelson & Winter, 1982).

These two analogies (organizational genes and organizational memory) to study routines led to accentuated differences in understanding. Although both analogies denote the role of routines in promoting stability and coordination as well change and dynamism, the genetic view aligns more with the first while the memory view with the latter (Parmigiani & Howard-Grenville, 2011). In the genetic view, routines change occurs in order to adjust the environment, thus, it happens gradually by means of the cycle of variation-selection-retention (usually known as VSR cycle). However, what drives firm value is rather a replication of routines rather than changes of themselves (Winter & Szulanski, 2001). Considering that routines are "sticky" and challenging to transfer across firms or even within the firm, the ones which drive firm performance and sustain the business model (called 'arrow core') should be replicated to enhance firm value (Winter & Szulanski, 2001). Hence,

replication strategies of routines endeavors not only short-term results but also long-term survival.

In turn, the organizational memory view is concerned mainly on how routines enable and constrain learning, and also how they embodied tacit knowledge (Kogut & Zander, 1992). For example, Zollo, Reuer, and Singh (2002) extended the concept of routines for inter-organizational activities (non-equity alliances in the biotechnology industry) where they align interests enabling cooperation and coordination. Maybe the best way to show how this view denotes change, is to rely on another biology parallel (Nelson & Winter, 1982): organizational memory is not "frozen" data like in a computer but is similar to the memory in human brain where past knowledge is "alive" because is refreshed receiving new meanings and applications (remembering by doing). In sum, while routines as genes contribute to the firm grow with replication, routines as memory contributes through changes in repetition.

2.2.2 Routines as buildings blocks of capabilities

The notion of routines as building blocks of capabilities can be traced at least to Collis (1994, p. 143): "[organizational capabilities are] socially complex routines that determine the efficiency with which firms physically transform inputs into outputs". This conception evolved incorporating the importance of resources – to be deployed by routines, repetition – consistency in performance and intentionality – choice of significant outcomes and how to get them (Dosi et al., 2000). Accordingly, "an organizational capability is a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type" (Winter, 2003, p. 991).

But what distinct capabilities from routines? First, capabilities are organizational variables while routines are lower-level ones. Second, capabilities mandatorily have a purpose and routines may not have one: they may be like an 'organizational habit'. Third, capability development and deployment are shaped by deliberative processes, but routines can become automatic. Thus, capabilities are larger units of analysis characterized by a collection of routines (or high-level routines) with

evident firm-level purposes (Dosi et al., 2000). There is empirical evidence to account to routines this role.

Dutta, Zbaracki, and Bergen (2003) investigated pricing capability because setting the right price requires a deep understanding of the financial and political dynamic of the firm and in relation to the client firms in order to appropriate the value created. Thus, pricing is not simple, occasional or even easy to transfer across firms. They found in a manufacturing firm a sort of interrelated routines such as negotiation with consumers, the creation of presentations and documentation of competitive prices supporting pricing capability.

Peng, Schroeder, and Shah (2008) started their study based on the distinction of Levinthal and March (1993) and March (1991) between capability for improvement of current business activities—exploitation—and capability for innovation in product and processes—exploration. According to them, improvement and innovation capabilities are the most relevant capabilities in operations management. Their results showed that these capabilities enhance operational performance, and also that each capability is a bundle of routines. Improvement capability relies on routines of continuous improvement, process management, and leadership involvement in quality. Innovation capability depends on the search for new technologies, process and equipment development, and cross-functional product development.

Thus, routines are the core element of capabilities in general, but also of a special type: the dynamic capabilities. They are a higher level capability whose the distinction of ordinary ones is the focus of the next section, and also have routines as its building blocks. The three main definitions of dynamic capabilities in the literature are in line with this understanding:

- Teece et al., (1997, p. 516): “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” where competences are “patterns of current practice and learning” (Teece et al., 1997, p. 518).

- Eisenhardt and Martin, (2000, p. 1107): “The firm’s processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which

firms achieve new resource configurations as markets emerge, collide, split, evolve, and die."

- Zollo and Winter (2002, p. 340): "A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness."

The definition of dynamic capabilities is a point of contention and there is no complete agreement among scholars, which has led to an 'excess' of literature reviews on the topic (Wilden et al., 2016). Although the emphasis varies among the definitions, all of them support the notion of routines as the core element of dynamic capabilities.

2.2.3 The hierarchy of capabilities: ordinary and dynamic capabilities

There are organizational capabilities regulating the level of adaptation of existing routines and capabilities to the firm's dynamic environment—a notion that the multilevel perspective of capabilities and routines accounts (Salvato & Rerup, 2011; Teece, 2014). Ordinary capabilities are the ones involved in the performance of basic functional activities such as the production of an existing product (Teece, 2014). Dynamic capabilities support the systematic and reliable adaptation of these ordinary capabilities to the changes in the environment (Helfat et al., 2007; Teece, 2007).

It is important to highlight that both classes of capabilities (ordinary and dynamic) are composed of a network of organizational routines (Feldman, Pentland, D'Adderio, & Lazaric, 2016), as argued in the previous section, but, as shown in **Table 3**, there are remarkable differences between them.

Table 3 – Some differences between ordinary and dynamic capabilities

Attributes	Ordinary capabilities	Dynamic capabilities
Purpose	Technical efficiency in business functions	Congruence with customer needs and with technological and business opportunities
Mode of attainability	Buy or build (learning)	Build (learning)
Tripartite schema	Operate, administrate, and govern	Sense, seize, and transform
Key routines	Best practices	Signature processes
Managerial emphasis	Cost control	Entrepreneurial asset orchestration and leadership
Priority	Doing things right	Doing the right things
Imitability	Relatively imitable	Inimitable
Result	Technical fitness (efficiency)	Evolutionary fitness (innovation)

Source: Teece (2014).

Ordinary capabilities comprise operational, administrative and governance functions technically necessary. They enable in these specific functions a degree of quality and excellence mainly in terms of operational productivity (Teece, 2014). Strong ordinary capabilities in this sense resemble best practices against a benchmarking in the industry. Although pursue best practices is relevant for daily operation, ordinary capabilities are not enough to achieve competitive advantage because these practices are built easily with training, bought from consulting firms or even outsourced in some cases (Helfat & Peteraf, 2003).

Moreover, ordinary capabilities do not envision the future, they follow the current conditions of the competitive environment (Teece, 2014). As soon as the environment changes, they become suboptimal at the best. Further, in the long term, best practices become traps: the ultimate consequence of mindless efficiency

is organizational inertia because fixed tasks increase productivity while changes and adaptation not (Teece, 2014).

In contrast, dynamic capabilities underlie build, renew and deploy resources within and beyond its boundaries (Teece et al., 1997). For example, systematic processes for strategic decision-making and resource allocation, transfer processes for replication and brokering, knowledge creation routines, alliance and acquisition processes, and exit routines for jettisoning products and businesses that no longer provide value (Eisenhardt & Martin, 2000).

The main driver of dynamic capabilities is the enterprise response to (or creating) changes in the business environment (Teece, 2007). This is possible because managers develop, validate and adjust conjectures while orchestrating changes in current routines. The idiosyncrasy due to the strong path dependence of these processes prevents them to be copied by the competitors (Teece et al., 1997).

'Ad hoc' problem solving or even innovation by itself does not reflect the level of dynamic capabilities (Teece, 1986; Winter, 2003). If ordinary capabilities result in technical fitness, functional effectiveness irrespective of firm living, dynamic capabilities deliver evolutionary fitness: they enable a firm to make a living in the selection environment (Helfat et al., 2007; Teece, 2007).

Teece (2014, p. 331) summarizes this distinction in an example: "In the fast-food industry, for example, ordinary capabilities involve key performance indicator metrics, training systems, motivation, monitoring, and so on. Dynamic capabilities address figuring out new products to put on the menu, new operating hours (e.g., late-night), and new locations (central versus suburban)".

2.3 Connecting micro-macro: cognition and dynamic capabilities

2.3.1 Behavioral theory in dynamic capabilities research

The studies of Eisenhardt and Martin (2000) and Teece et al., (1997) centralize two different clusters of research on dynamic capabilities (Giada Di Stefano et al., 2010; Peteraf, Di Stefano, & Verona, 2013). Studies around the first one follow a logic based on organizational studies and emphasize processes within organizations'

boundaries, such as firm learning. The second cluster concentrates studies that privilege an economic logic and, therefore, underscore processes beyond organizations' boundaries, such as market dynamism. While the latter view can be framed as the mainstream, the first one shares a lot with the Behavioral theory (see Section 2.1).

Considering the extent the tension between the clusters have limited the research development of dynamic capabilities, Arndt et al., (2017) outline four main areas for future research to bridge the clusters: (1) selection of business models, (2) investment decision criteria and choices, (3) development and acquisition of complementary and co-specialized assets, and (4) asset orchestration activities of management.

Business models are one of the key elements of any strategy, they represent the architecture of the business. These organizational arrangements are at the heart of successful companies such as Dell in PC Business or Wall-Mart in retailing, but also behind the failure of Sony's Betamax technology (Teece, 2014). However, business models development does not seem to stem from organizational routines, neither 'ad hoc' processes (Winter, 2003). Decision-making processes and insights could help to inform these dimensions of dynamic capabilities. Further, the examination of business model under the understanding that they are a different phenomenon and not inevitably related to technology innovation and radical product innovation, can help to explain it (Arndt et al., 2017; Markides, 2006)

A similar idea can be applied to investment decisions and asset orchestration. Arndt et al., (2017) recognize two classes of investments, the small ones which tend to be related to routines since they are incremental and the large ones, usually irreversible, such as major mergers and acquisitions that are usually under the judgment of the top management team. Although a fraction of these larger investment decisions can be routine (e.g. legal due diligence, valuation), managerial judgment plays a key role in these processes (Laureiro-Martínez et al., 2015).

Orchestration of assets can be a relevant source of competitiveness. These assets can be bought or build internally, but their unique value derives from specific combinations inside the firm (Augier & Teece, 2009). Since most of these assets are idiosyncratic and/or their value rely on particular combinations, there is virtually no market for them. Therefore, asset orchestration is an important element of

dynamic capabilities in which value creation is directly related to managerial judgment (Arndt et al., 2017).

Another important area of research is the multilevel nature of dynamic capabilities, from cognition to collective levels (Laamanen & Wallin, 2009). For example, Laamanen and Wallin (2009) found distinct effects of managerial cognition in three levels of dynamic capabilities: operational capability (instrumental cognition), portfolio of capabilities (management's attention) and enterprise capabilities (managerial foresight). Future research should address not only the interactions of managers across different levels but also capabilities and resources available in each level and the influence of multiple organizational structures (Arndt et al., 2017), a research program in line with the triad routines, cognition and hierarchy suggested by Gavetti (2005).

Finally, despite the central role of learning in dynamic capabilities (Zollo & Winter, 2002), existing research has not fully connected capability development to cognition, rationality, hierarchy or even the notion of space for failure vs. learning over time (Arndt et al., 2017). Recent research has the potential to inform the effect of learning from peers (Chan, Li, & Pierce, 2014), reflection (Di Stefano, Gino, Pisano, & Staats, 2016) and social norms (Di Stefano et al., 2014) for capability creation. A promising idea in this area is the study of spinoffs to examine how dynamic capabilities reside at management practices. If source firms are relevant for spinoffs' success, the organizational routines learned in the source firms may be the explanation (Klepper & Sleeper, 2005). The following section (Section 2.3.2) explores the role of individual agency and action in routines and capabilities.

2.3.2 The role of individuals in routines and capabilities

The notion of routines as patterns of organizational behavior underlies an assumption of mindless operation unless an external perturbation (Cohen, 2007). Routines here lack intentionality and follow the idea of heuristics, automatic decisions or recurrent situations. According to Cohen (2007), this notion sees routines primarily as habits, rejecting cognition and emotion as constituent elements of routines. Consequently, individuals' role is irrelevant for routines emergency, enactment or release. However, there is evidence against this notion in favor of the human agency.

Parmigiani and Howard-Grenville (2011) offer some examples such as (i) the overconfidence or the incompetence of individuals to leverage or undermine routine adoption, (ii) social interaction between individuals shape their adherence to routines and (iii) training of specific individuals can diffuse routines. Other factors are identity, motivation, experience, and power that prevent or support routines to be fulfilled as they were designed. Indeed, Gavetti (2005) suggests that firm behavior is a function of the triad routines, cognition, and hierarchy. For the author, the excessive focus on the rule-based logic of organizational routines has led to the oversimplification of the phenomenon, overlooking the individual calculative intervention and the organization design setting.

Understanding decision rules as organizational routines implies a greater degree of mindfulness (Cyert & March, 1963; Levinthal & Rerup, 2006). The routinization indeed can save cognitive efforts, but as a mechanism of choice does not eliminate individual choice. A major development in organizational routines research was the elaboration of Feldman and Pentland (2003) on the performative and ostensive aspects of routines, first introduced by Feldman (2000). While the ostensive aspects take into account the 'cognition' of routines such as representation and intention – "abstract, generalized idea of the routine", the performative ones denote the actual performance - "specific actions, by specific people, in specific places and times" (Feldman & Pentland, 2003, p. 101).

These dimensions are not different elements or even constitute alternatives of what a routine could be, together they represent two sides of the same coin. According to Feldman and Pentland (2003), ostensive aspects guide action at the time performative aspects recreate the representation imagined. That entails that the deliberated ostensive intent behind a given routine may differ significantly from the performance accomplished. In sum, they provided an ontology based on a duality of agency and structure that denotes a complementary internal dynamic within organizational routines. Moreover, this concept helps to understand how routines can change over time, given that the pattern of continuity is their main characteristic. However, further developments based on this dual character of routines are disproportional with the most significant contributions remaining on the performative perspective (Becker, 2005; Cohen, 2007).

Organizational routines encompass a duality in its effects: endeavors stability and change (Becker, 2004). Disregarding issues related to aggregation, as dynamic capabilities are a network of routines, they also have the same characteristics, yet

the weight of change is greater in dynamic capabilities than in routines (Zollo & Winter, 2002). These parsimonious explanation of dynamic capabilities is limited in some sense (Salvato & Rerup, 2011): how these pattern and persistent behaviors enable the creation of novelty and human creative? How high-level routines foster strategic innovation?

The introduction of dynamic capabilities as decision-making activities based on individual skills helps to answers these questions (Helfat & Peteraf, 2015; Teece, 2007). Individuals are the primary explanation of processes such as recognition of opportunities and the envision of new products or business models (Eggers & Kaplan, 2013; Felin et al., 2015; Teece, 2014). Actually, the heart of dynamic capability relies on "asset orchestration" function which is supported by three sets of organizational processes essentially informed by human agency: (1) coordination/integration, (2) learning, and (3) reconfiguration (Teece, 2007).

Thus, dynamic capabilities framework is premised on learned behavior from the past (organizational routines) (Zollo & Winter, 2002) and also deliberative action to create and change (decision-makers) (Teece, 2014). For example, Polaroid in the 1980s had capabilities well-developed and strongly rooted in a business model that would become outdated, but it did not have decision-makers to break the path dependence (Tripsas & Gavetti, 2000). In contrast, since the later 1980s, Apple lacked organizational capabilities to translate Steve Job's creative action into products and consumer experience, only at the begging of the 2000s the company returned to successes (Heracleous, 2013). Thus, in order to reconfigure resources addressing environmental changes, firms need the reliability of processes and the creativity of individuals (Helfat et al., 2007).

According to Teece (2014), the role of individuals can actually be the origin of competitive advantage in the dynamic capabilities framework. That is because as the management team evolved and routinize their decision-making activities, they create 'signature processes' depth rooted in context-learning during the company's history. Another firm cannot easily recreate this kind of routines embedded in the original organizational culture. Moreover, signature processes are ambiguous externally increasing uncertainty on what competitors should imitate (Teece, 2014). Thus, capability and firm heterogeneity can be largely accounted to individuals.

2.3.3 Dual-process and dynamic capabilities

The study of cognition in organizations spans to different focus and domain of application. According to Hodgkinson and Healey (2008) this domains are (i) personnel selection and assessment, (ii) workgroups and teams, (iii) training and development, (iv) stress and occupational health, (v) work motivation, (vi) work design and cognitive ergonomics, (vii) leadership, (viii) organizational decision-making, (ix) organizational change and development and (x) individual differences. In this section, the focus is on the decision-making process, which follows Simon's (1957) work: a variety of cognitive limitations bounded individuals trying to maximize their utility.

Organizational research in decision making has been mainly informed by one area of psychology – behavioral decision theory (Neale, Tenbrunsel, Galvin, & Bazerman, 2006). This area uses normative models as a means to identify and explain the regularities of failures in human decision processes. While the rational decision view believes that these failures can be explained as a result of inattention, ignorance, or error, the behavioral decision theory took these failures to start a new research program. The importance of this research program can be linked to three Noble Prizes in Economics. First, Herbert Simon by showing to economists the importance to introduce perceptual, psychological and cognitive aspects in the study of decision processes. Second, Daniel Kahneman by his theory of heuristics and biases behind common decision errors. Third, Richard Thaler by his contributions to behavioral economics, such as "nudging" strategies.

Here, it may be relevant to know that cognitive processes can be assembled into two categories: System 1 (Intuition) and System 2 (Reflection) (Evans, 2003; Stanovich & West, 2000). This first one encompasses processes that are unconscious, rapid, automatic, implicit and emotional, while later encompasses those that are conscious, slow, logic and deliberative (Evans, 2008). **Table 4** synthesizes the main attributes of each system.

Table 4 – Attributes associated with dual systems of thinking

System 1 (Intuition)	System 2 (Reflection)
❖ Unconscious	❖ Conscious
❖ Implicit	❖ Explicit
❖ Automatic	❖ Controlled
❖ Low effort	❖ High effort
❖ Rapid	❖ Slow
❖ High capacity	❖ Low capacity
❖ Default processes	❖ Inhibitory
❖ Holistic	❖ Analytic
❖ Perceptual	❖ Reflective

Source: Adapted from Evans, (2008, p. 257).

Accordingly, judgments tend to be subjected to biases that are associated with System 1. Analytic reasoning, which is linked to System 2, might interfere with these biases of System 1 and improve its processes (Kahneman & Frederick, 2005). Heuristics are simplifying strategies or 'rules of thumb' that people rely on when making decisions (System 2). They have a dual effect because at the same they reduce the chances of finding the optimal solution, they also reduce the time spent searching and evaluating alternatives (Neale et al., 2006). In the strategic context, where the decisions are complex and highly uncertain, the time and resources involved in a full search can easily overcome the benefits. Although preventing people from a full search, the heuristics simplify decision processes and, more importantly, produce in general correct or partially correct answers (Hodgkinson & Healey, 2008). The main drawback is the fact that individuals may not be aware of the heuristics, leading to misapplications where the results can be undesirable.

Tversky and Kahneman (1974) identified three main heuristics in human behavior: availability heuristic, the representativeness heuristic, and anchoring and adjustment heuristic. Availability refers to the extent the instances or occurrences of an event is 'readily' available in memory. Thus, individuals tend to believe that events that they remember are more likely to happen, which is not always true (Tversky & Kahneman, 1973, 1974). For example, the manager's memory of recent successes in product launch biases his forecast of a new product. The availability in memory is given not only by reoccurrence, but it is subject to the effect of other

factors such as affect and emotions: events rooted in emotions can be ‘retrieved’ easily than the ones unemotional or bland (Neale et al., 2006).

Representativeness heuristic represents the tendency of an individual to judge the likelihood of an event’s occurrence based on the similarity to their stereotypes, thus, assuming the likelihood of a known comparable event to predict the unknown event (Kahneman & Tversky, 1972; Tversky & Kahneman, 1974). This is not a problem ‘per se’. Individuals create categories while accumulated experience when something new does not fit in the existing categories, they approximate to the closest one. However, the bias occurs in the tendency to extend the similarity in one aspect (i.e. population characteristics or processes generation) to another one (i.e. probability). For example, managers forecast the success of a new product based on how similar it is to other products.

Anchoring and adjustment heuristic, the last one of the three presented. When people make an estimation, they chose a starting point to ‘anchor’ and subsequently adjust this value to reflect conjectural changes (Tversky & Kahneman, 1974). This ‘anchor’ can be traced to historical values, the structure of the problem presented or even arbitrary information (Neale et al., 2006). For example, starting the precification process of a new product by the profit target. In an ambiguous decision, the inconsequential choice of the initial value can be profound effects, no matter how sophisticated are the adjustments. Therefore, the anchor effect is manifested by the direction of an estimation towards a value previously mentioned or considered (Tversky & Kahneman, 1974).

The main critique of behavioral decision theory rests on external validity, that is, how well in real-world conditions (Hodgkinson & Healey, 2008). The argument underlying the critique rests on the belief that individuals learn during the time (responsive learning), which eliminates the biases in heuristic decisions (Garb, 1989). Thus, performance feedback act as a correction mechanism improving information use and decision-making processes. Besides the robustness of behavioral decision theory findings in real-world research designs (Bazerman & Moore, 2013), Tversky and Kahneman (1986) offer four reasons to not cope with the responsive learning argument: (1) results are frequently delayed and hard to link to a precise decision, (2) environmental variability creates noise on the feedback, (3) usually there are no information on the results of alternative actions and (4) the opportunity for learning is small or null as the relevant decisions are unique. Later,

in the development of the second hypothesis (Section 2.4.2), the effect of feedback on dynamic capabilities will be discussed.

System 1 underlies rapid, automatic and unconscious forms of cognition (e.g. empathizing with others) and System 2, is given by slow, rational and analytic reasoning (e.g. hypothetical thinking) (Lieberman, 2007). According to Evans (2008), a shift among scholars occurred in the understanding of the relationship between the systems 1 and 2, from "default interventionist" to "parallel-competitive" dual-process models.

In the default interventionist model, System 2 refines the responses accounted to System 1. Therefore, "the role of cortical/higher mental functions is to correct the 'primitive' limbic system's automatic and affective responses" (Hodgkinson & Healey, 2014, p. 1308). "Parallel-competitive" models offer an alternative analysis, where, instead of viewing the automatic system as a source of error and bias, they saw it as critical for skilled processes such as intuition (Lieberman, 2007). Thus, in these models, automatic and controlled systems are simultaneous processes competing for control (Hodgkinson & Healey, 2014).

The parallel-competitive models are receiving increasing attention from the strategic management literature (e.g. Håkonsson et al., 2016), however, the dynamic capabilities literature still remains under the default interventionist model. For example, the Teece's framework (2007) of the microfoundations of the dynamic capabilities only acknowledges the System 1 indirectly, as a cause of decision bias. Implicitly, this line of thinking follows a default interventionist model, where the reflective System 2 should control System 1 (source of bias).

According to Teece (2007), the microfoundation of dynamic capabilities in terms of cognition relies only on avoiding bias, delusion, deception, and hubris. He advocates that low routinized decisions, especially in dynamic environments and turbulent situations, become more susceptible to errors and biases (Nelson & Winter, 1982; Teece, 2007). Therefore, the microfoundations of dynamic capabilities which can lead to competitive advantage rely on a "cognitively sophisticated and disciplined approach" such as "look at objective (historical) data" (Teece, 2007, p. 1333).

A noteworthy process of the System 1 and also focus of this study is intuition (Lieberman, 2007), described by Plessner, Betsch, and Betsch (2008, p. 4) as "(...)

a process of thinking. The input to this process is mostly provided by knowledge stored in long-term memory that has been primarily acquired via associative learning. The input is processed automatically and without conscious awareness. The output of the process is a feeling that can serve as a basis for judgments and decisions". Thus, intuition is neither insights or instincts. Hodgkinson, Sadler-Smith, Burke, Claxton and Sparrow (2009, p. 279) offer an easier explanation of intuition as "a judgment for a given course of action that comes to mind with an aura or conviction of rightness or plausibility, but without clearly articulated reasons or justifications – essentially 'knowing' but without knowing why".

The characteristics of intuition further the notion that it has a close relationship to dynamic capabilities. First, intuitive decisions are more likely to provide better answers in unstructured situations where well-defined policies cannot find traction (Shapiro & Spence, 1997). The fact that intuitive decisions are usually more valuable in settings where the level of structuredness is low traces a direct link to the contingency where dynamic capabilities emerge. Second, intuition also involves making holistic, therefore providing 'big picture' analysis (Dane & Pratt, 2007). Rather than attention to details, strategic decisions where dynamic capabilities take place demand associative thinking and understanding of the scenario as a whole.

Second, the accumulated expertise allows decision-makers to easily understand a given situation and decide what way to proceed (Hodgkinson et al., 2009). That is because decision-makers rely on complex, domain-relevant mental representations (known as schemas) and associated action scripts (Akinci & Sadler-Smith, 2012). These structures can help individuals not only to quickly understand what is the right decision but also instantaneous awareness of something wrong in the context when reading the environment. The pace of change in environments is a relevant key to understand dynamic capability (Helfat & Winter, 2011). While something is always changing in the competitive environment due to incremental and granular variations, the dynamic capability framework provides an explanation for firm adaptation especially in contexts of turbulence, technological change and market dynamism (Wang & Ahmed, 2007). Therefore, as intuition support fast decision, it enhances the reliability of firm capacity to address environmental changes in time.

Third, intuitive thinking enables individuals to produce associations from novel and unexpected connections among distinct elements (Ilg et al., 2007). Operating in the long-term memory, intuitive thinking build on previous learning and experience

to elaborate new ideas viewing parts as interrelated and understanding them as a whole (Phillips, Fletcher, Marks, & Hine, 2016). Thus, individuals can incorporate disconnected elements of an unstructured problem into an articulated decision (Akinci & Sadler-Smith, 2012). This third characteristic of intuition underscores another dimension for dynamic capability, timely decisions are not enough if they lack content. The fast-moving business environment is characterized by a geographic dispersion of knowledge sources (Teece, 2007). In such a scenario, decision-makers do not have complete information about the strategic options and the related outputs to analyze. Intuition supports a holistic view of the scene by recognizing an implicit pattern behind the noise, and thus, the degree of discovering opportunities (Rae & Wang, 2015). Also, original and surprising associations of elements foster firm innovation through new product systems and new business models (Teece, 2014).

2.4 Conceptual framework and hypotheses development

According to the dual-process theory of reasoning, cognition is the result of interactions between intuitive and reflective processing (Evans, 2008; Tversky & Kahneman, 1974). Intuition is fast, affective, unconscious, automatic, heuristic in nature. Reflection, by contrast, is slow, effortful, conscious, controlled, and rational (Hodgkinson et al., 2008). Because intuition gives an automatic response while reflection yields a calculative one, both processes might favor different alternatives and compete to determine the decision maker's final choice (Lieberman, 2007). Intuition relates to accumulated knowledge gained through associative learning experience: people internalize strategies (e.g. heuristics) that are typically advantageous and successful in their daily decisions (Ilg et al., 2007; Reber, 1989). Consequently, the efficiency of intuition versus reflection is usually attributed to the decision environment: while intuition leads to behavioral responses that are advantageous in most of the situations, reflection may override suboptimal intuitive responses in atypical situations (Laureiro - Martínez & Brusoni, 2018).

This view that reflection leads to better outcomes in atypical settings, such as strategic change, usually holds for isolated one-shot decisions (Rand, 2016). Indeed, most of the research in management endorses that understanding, though mainly supported only by correlational studies. However, rather than isolated one-

shot appropriate decisions, capabilities reflect a consistent behavior: business tasks repeated over time (Pentland & Rueter, 1994). Accordingly, the notion of routines as the building blocks of capabilities echoes from Collis (1994, p. 143): "socially complex routines" to Zollo and Winter (2002, p. 340): "a learned and stable pattern of collective activity" passing by Teece et al., (1997, p. 516): "patterns of current practice and learning". Thus, while previous research has considered decision-making as the micro-level unit of dynamic capabilities, we take habits as a reference (Winter, 2013). Both choices capture only partly the organizational phenomenon, but we contend that habits an advantageous representation of firm capabilities because of the conceptual correspondence.

First, habits embody routinization since they are context-response associations formed in the procedural memory: the repeated covariance of actions and environmental cues when individuals pursue a given goal (Wood & Rünger, 2016). Second, habits have a social/collective dimension as individuals develop action dispositions in organizational routines by repeated experiences that translate into an interlocked structure of habits (Hodgson & Knudsen, 2004). In the organizational setting, the repeated cross-group interactions where people face social rewards (e.g. approval) that covariates with group-level cues create habits (Hackel, Doll, & Amodio, 2015; Wood, 2017). Moreover, considering habits as the underlying dimension of firm routines is consistent with the evolutionary roots of dynamic capabilities (Cohen & Bacdayan, 1994; Hodgson & Knudsen, 2004). Precisely, we are interested in the effect of intuition and reflection on dynamic capabilities: the firm ability to adjust their routines to cope with an exogenous shock (Zollo & Winter, 2002). In this sense, habits provide a suitable theoretical framework to link cognitive processing (micro-level) to routine adaptation (macro-level).

2.4.1 The role of cognitive processing

Between the two modes of cognitive processing, the most recent literature in behavioral change suggests that reflection hamper routinize adaptation (Carden & Wood, 2018; Gillan, Otto, Phelps, & Daw, 2015; Wood, 2017). This is due mostly because changing a routinized behavior requires both (i) to weak the old context-responses and (ii) the repetition of the new routine (Wood & Rünger, 2016). Conversely, reflection increases the salience of task features, which prevents changes in the implicit context-response associations (Austin & Kwapisz, 2017), and

demands a high level of cognitive effort to engage, which is hard to sustain for repetition throughout long periods (Bear & Rand, 2016; Kool, McGuire, Rosen, & Botvinick, 2010). Further, reflection facilitates self-serving rationalizations in which individuals find reasons to return to the previous routine instead of changing it (Galla & Duckworth, 2015; Milyavskaya, Inzlicht, Hope, & Koestner, 2015). As a result, reflection promotes short-term change and individuals fail in adapting their routinized behavior.

In addition, while reflection hinders habit change, intuition has two main features that are relevant during routine adaptation: speed and holistic view. First, intuitive processing relies on low-level cognitive processes that are triggered automatically and reflexively (Bear & Rand, 2016). As a consequence, when the most adaptive responses are updated, it enhances the reliability of routines to address environmental changes in time. This characteristic is consistent with previous research in management showing that investors use their intuition for capturing opportunities timely (Huang & Pearce, 2015). Second, timely responses are not enough if they lack content. Intuition supports problem-solving by recognizing an implicit pattern behind the noise (Dane & Pratt, 2007; Huang & Pearce, 2015). Indeed, research on psychology shows that individuals are usually unaware of this context-response in their routinized behavior (Wood, 2017). Operating in the long-term memory, intuitive processing builds on previous learning and experience to elaborate new patterns viewing parts as interrelated and understanding them as a whole (Hodgkinson & Healey, 2011; Phillips et al., 2016). In sum, intuition should be preferred to reflection regarding routine adaptation. Accordingly, we suggest:

Hypothesis 1: All else constant, intuition (versus reflection) increases dynamic capabilities.

2.4.2 The role of feedback opportunity

Equally important as the firm internal resources, it is the competitive context (Teece et al., 1997). Environmental dynamism is one of the key variables in the dynamic capabilities framework (Wang & Ahmed, 2007), although it is not a precondition for dynamic capabilities existence (Helfat & Winter, 2011). The extant literature disagrees if dynamic capabilities are more valuable in highly turbulent environments (Teece et al., 1997) or in moderate turbulent ones (Eisenhardt &

Martin, 2000). However, empirical examination derives environmental dynamism as the level of volatility and unpredictability which can be measured as instability in sales and net assets (e.g. Schilke, 2014).

The environment of a firm is "the totality of physical and social factors that are taken directly into consideration in the decision-making behavior of individuals in the organization" (Duncan, 1972, p. 314). Several studies have argued that environmental dynamism translated into a treat to competitive advantage by reducing feedback-learning opportunities (Nadkarni & Chen, 2014; Nadkarni & Narayanan, 2007). Accordingly, with reduced feedback opportunities, it becomes a challenge to understand what are the impacts of decisions and to know fast enough to adjust the routines (Eisenhardt & Martin, 2000). Kahneman and Klein (2009) affirm that feedback provides the opportunity to learn from the environment as long as the feedback is not sparse or delayed, but fast and specific.

The behavioral literature considers that lower feedback opportunity may weaken routine adaptation in two main ways (Levitt & March, 1988). First, directly, lower feedback hampers the creation of matching patterns of behaviors to situations that underlie organizational routines as they change incrementally in response to feedback about outcomes (Levitt & March, 1988; Nadkarni & Chen, 2014; Puranam, Stieglitz, Osman, & Pillutla, 2015). Second, indirectly, lower feedback changes the aspiration levels that drive organizational routines (Levitt & March, 1988). Thus, not only historical aspirational levels for time t might be misinformed because of lower feedback in t−1, but also, as a result, the subsequent performance evaluation is misinformed when comparing outcomes from t+1 to biased aspirational levels from t.

Therefore, feedback opportunity enables firms to updated information and adjust their routines to cope with environmental change. Following this logic, we predict:

Hypothesis 2: All else constant, higher feedback opportunity (versus lower) increases dynamic capabilities.

2.4.3 The interaction between cognitive processing and feedback opportunity

The fit between cognitive processing and competitive environment may render superior firm adaptation (Levine, Bernard, & Nagel, 2017). Thus, we also propose an interaction effect between cognitive processing and feedback opportunity. Low feedback opportunity reduces the information available, making planning and analysis more difficult, in other words, the learning input for reflection is constrained (Nadkarni & Chen, 2014). Therefore, individuals cannot establish explicit causal relationships to inform their decisions (Kahneman & Klein, 2009). Regarding intuition, low feedback opportunity generates dysfunctional learning which in turn weakens intuition effectiveness (Salas, Rosen, & DiazGranados, 2010). That is because the linkages underlying intuition do not represent reality accurately, as a result, the intuitive implicit associations become loose. Hence, at first glance, environments with low feedback opportunities should jeopardize routine adaptation, either individuals adopting intuitive or reflective cognitive processing. However, we suggest that differences in the underlying learning processes of intuition and reflection might explain heterogeneous effects on routine adaptation conditional to the environmental feedback opportunities (Evans, 2008).

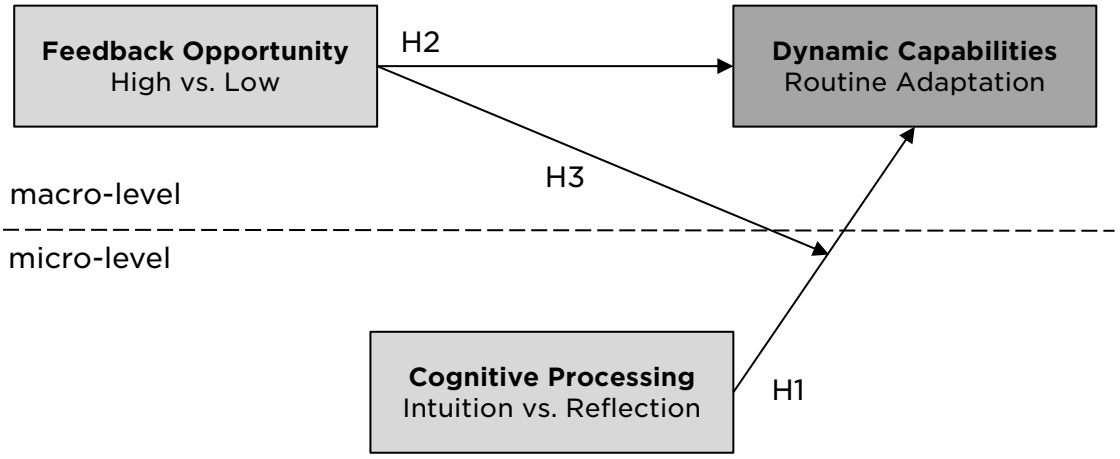
Feedback opportunity is not equally important for both intuition and reflection when it comes to adaptive routinized behavior. While individuals deprived of feedback cannot cope with routine change using reflective processing because there is not enough explicit information to be processed, they might adapt routinized patterns using intuition precisely because less feedback is available. Since routinized behavior enacts habitual responses trigger by context cues (Wood, 2017), turbulent environments make feedback cues less salient and the memory to perform routines is no longer activated (Cohen & Bacdayan, 1994). Less constrained from the previous routinized behavior, individuals can form new implicit associations and adapt their routines based on the feedback from other contextual cues—which are mostly unaware for the individuals performing the routines (Gillan et al., 2015; Liljeholm, Dunne, & O'Doherty, 2015). Thus, in the absence of enough information for reflection, routine adaptation follows a trial and error learning process (Gavetti & Levinthal, 2000) which repetition, in turn, shapes the implicit learning associations related to intuition (Salas et al., 2010). Accordingly, we propose:

Hypothesis 3. The lower the feedback opportunity (versus higher), the stronger the effect of intuition (vs. reflection) on dynamic capabilities.

2.4.4 Research framework

Figure 2 shows the research framework. The fundamental hypothesis is that intuition rather than reflection can enhance dynamic capabilities. In this context, we examine the effect of feedback opportunity because a turbulent environment difficult the link between choices and consequences, which in turn impacts both the cognitive processing–dynamic capabilities link and dynamic capabilities itself.

Figure 2 – Research framework



In sum, **Figure 2** underscores the following research question: how cognitive processing affects dynamic capabilities? In the following, the methodological choices to examine the research framework rationality are presented.

3. METHOD

3.1 Methodological approach

Our theoretical framework links cognitive processes to firm capabilities. Testing these relationships is empirically challenging because to isolate this sort of cognitive mechanism from other variables in real-world organizations is extremely complicated (e.g. endogeneity issues). Following the recommendations of Salvato & Rerup (2011) and Foss, Heimeriks, Winter and Zollo (2012), this research employs a laboratory experiment to address the research problem. The use of experimental designs is growing in organizational research, for example, it has been used to examine transferred knowledge (Di Stefano, King, & Verona, 2014), resource allocation (Agarwal, Anand, Bercovitz, & Croson, 2012), organizational routines (Håkonsson et al., 2016; Laureiro-Martinez, 2014), dynamic capabilities (Wollersheim & Heimeriks, 2016) or even country brands (Santos & Giraldi, 2017).

An experimental design has the core advantage over other methods of providing cause-effect relationships and, therefore, high internal validity (Grant & Wall, 2009). On another hand, the simplification of the experimental scenario can reduce external validity. Regarding the dynamic capabilities research, the experimental approach overcomes three main challenges of usual approaches: (1) fragile measures of dynamic capabilities, (2) lack of contra-factual evidence and (3) tautological research designs (Wollersheim & Heimeriks, 2016). In this sense, a laboratory-based design provided support to advance theory by isolating our theoretical mechanisms.

3.2 Experimental task

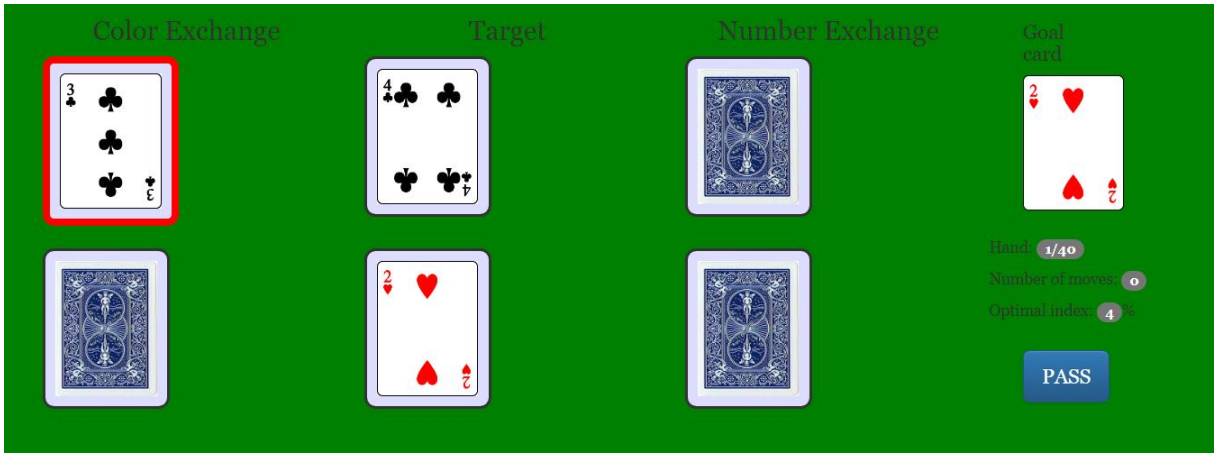
The experimental task is a computerized version of the card game Target the Two developed by Cohen and Bacdayan (1994) and later adapted for other studies in organizational theory (Egidi & Narduzzo, 1997; Garapin & Hollard, 1999; Wollersheim & Heimeriks, 2016). According to Winter (2013), this task is a promising avenue to investigate the microfoundations of dynamic capabilities. The game

offers a laboratory setting with “miniature organizations with behavior patterns that are organizational routines” (Cohen & Bacdayan, 1994, p. 559). According to the authors, the task provides patterns of behavior with four characteristics like field-observed organizational routines: reliability, speed, repeated action sequences, and occasional suboptimality. Similar to the managerial context, participants face a problem-solving where they can take advantage of learning (i.e. it is not random), but there is variability in the situations presented. They work together coordinating their actions. Thus, we selected an experimental task that captures the main dimensions related to organizational routines, which are essential for our theory development.

Cohen and Bacdayan’s (1994) card game involves a board with six cards (2♥, 3♥, 4♥ and 2♣, 3♣, 4♣) and the goal is to move the 2♥ to the target position. In each hand, the configuration of the six cards varies across the following positions on the board: two cards lying face down, two cards lying face up and one card with each participant. One of the cards lying face up is in the target position.

Figure 3 shows the board of Target the Two game. The deck area is on the left side (larger) and the control zone is on the right side (smaller). The control zone informs: (1) hand: indicates the hand of the game, (2) number of moves: indicates the total numbers of moves made during that round so farm and, (3) optimal index: indicates, in percentage, how close the participant is to the minimum ideal number of moves during that hand.

Figure 3 – The board of Target the Two game

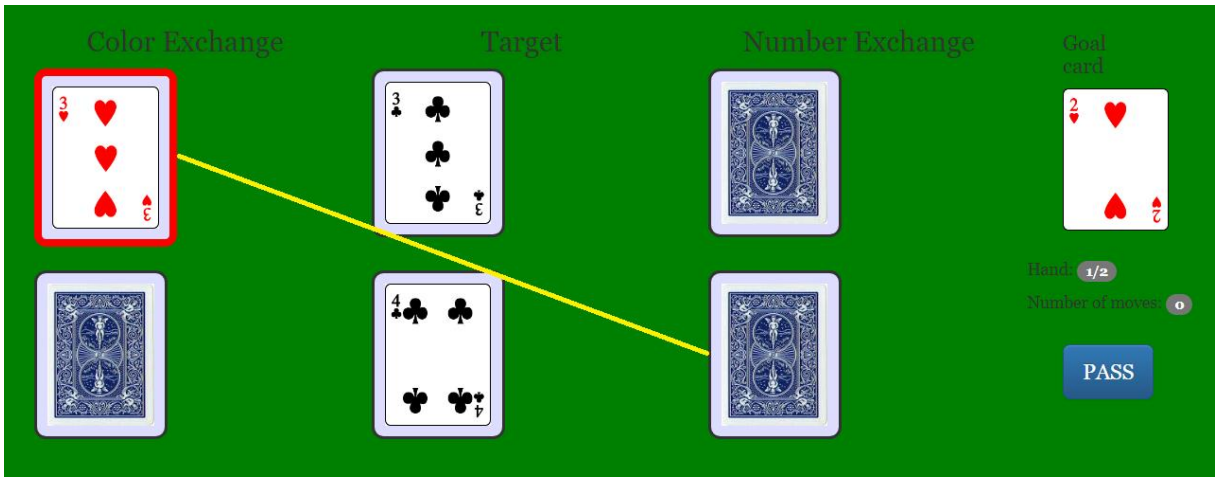


Note. The card in the participant's hand is highlighted with a red frame.

The participants cannot see each other cards, thus, each participant is aware of only half of the board (her own card and the other two lying faceup). Each participant can exchange her card only with one of the four cards lying on the board or pass her turn. A special rule restricts one participant to only exchange with the target position if both cards are of the same color (Color Keeper), while the other participant can only exchange if both cards share the same number (Number Keeper). This rule does not apply to other cards on the board. The participants alternate in the moves until 2♥ is placed in the target position. No explicit communication is allowed, the participants must coordinate their actions implicitly by their moves. Next, we present a hand sample to illustrated the game dynamic:

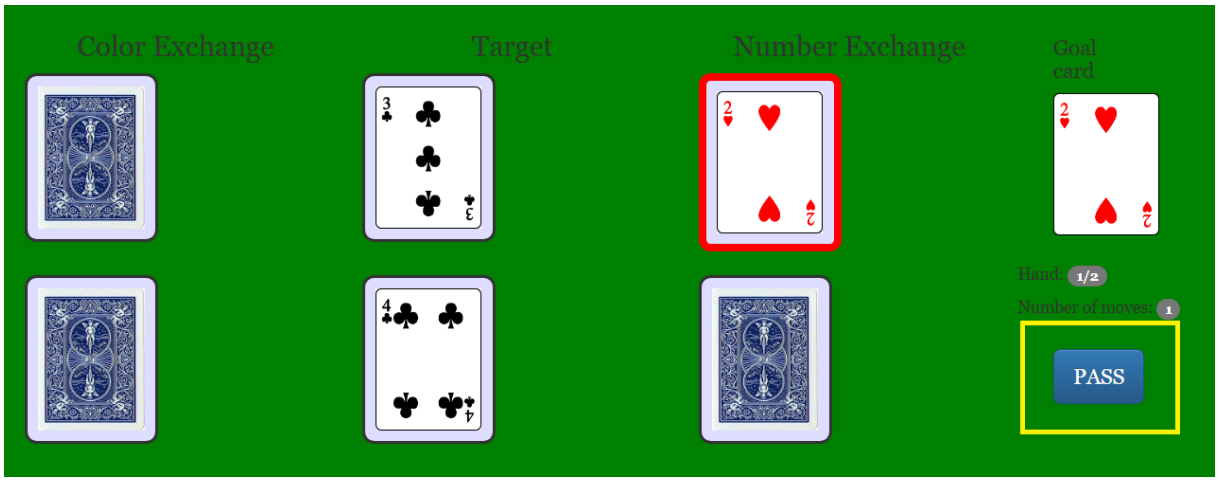
- **Figure 4**: The game starts with the player in the "Color Exchange" position (3♥ in red frame). Since the card in her hands cannot be moved to the target position because they do not have the same *color*, she decides to exchange her card with one of the lower side of the deck.

Figure 4 – Hand sample 1/4



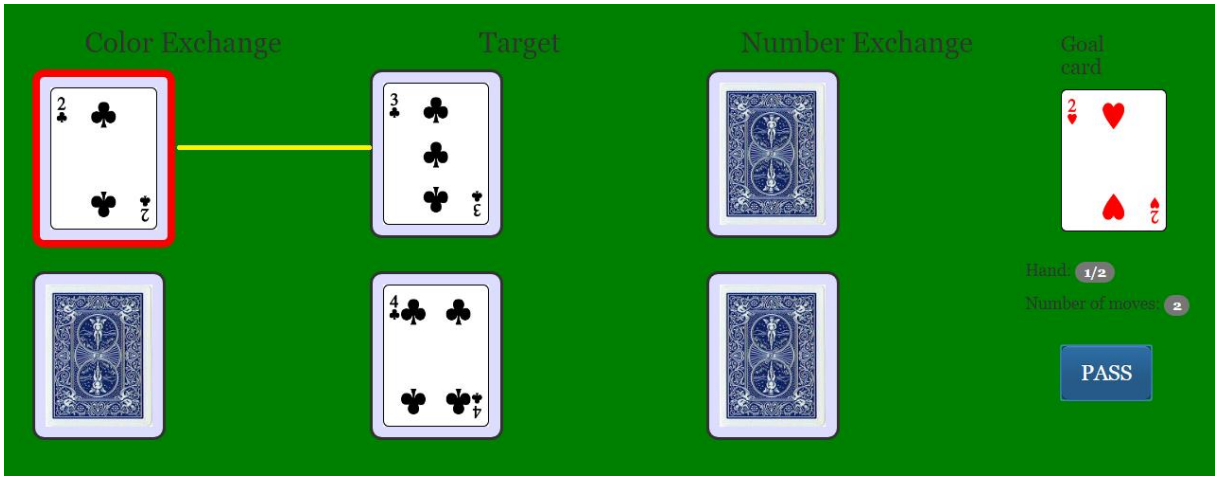
- **Figure 5**: Next, is the turn of the player in the "Number Exchange" position. She decides to pass her turn as she realizes that she already has the goal card (2♥), but she cannot move it to the target position yet because the cards don't have the same *number*.

Figure 5 – Hand sample 2/4



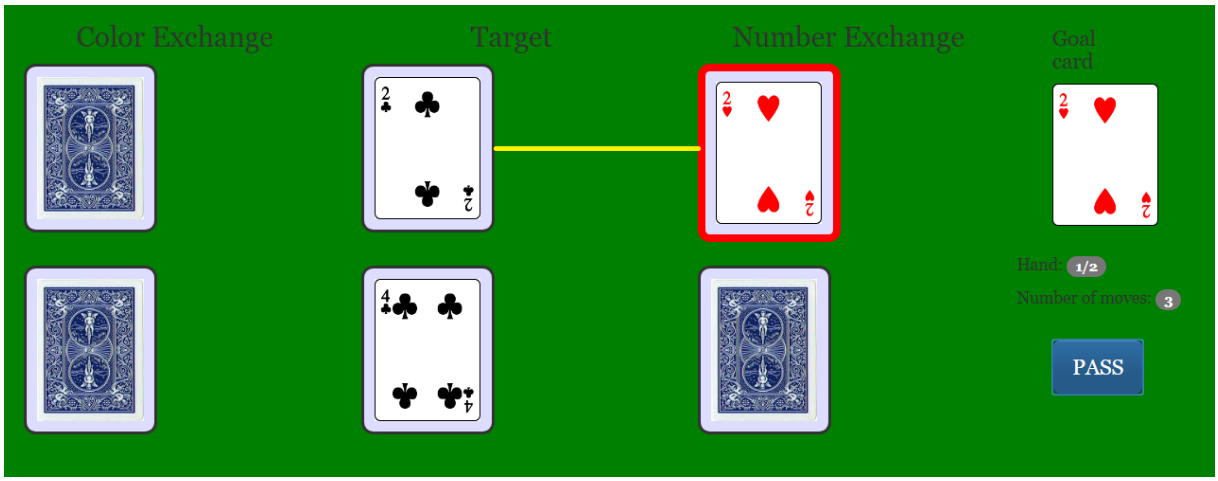
❖ **Figure 6**: Now, in her turn, the "Color Exchange" position player decides to move her card (2♣) to the target position (3♣), since the cards now have the same *color*.

Figure 6 – Hand sample 3/4



❖ **Figure 7**: Finally, the "Number Exchange" position player can move the goal card (2♥) the target position since both cards have the same number. Thus, the hand ends. In this sample hand, participants solved the hand with 4 moves.

Figure 7 – Hand sample 4/4



We instructed the participants to play two rounds of the game: they solved 40 hands up to 40 minutes in each round. We used the same 80 configurations of cards on the board designed by Cohen and Bacdayan (1994). These configurations vary in terms of moves required to solution and are ordered randomly. Accordingly, we induce participants to develop a routinized problem-solving behavior in the first round. Thus, participants will engage in a process of learning by repetition, developing a pattern of behavioral and cognitive activity (Feldman & Pentland, 2003; Zollo & Winter, 2002).

Before the second round begins, and without prior warning, a novelty manipulation was introduced through role switch and adjusted objective of the game: we informed participants a rule changed, the goal of the game become put the 2♣ in the target position (rather than 2♥) and they should reverse their roles (from Number keeper to Color keeper and vice versa). The second round aimed to assess the degree of dynamic capability of each team. This manipulation challenges the participants to understand a new situation and adjust their routines in order to cope with environmental changes (Teece et al., 1997; Zollo & Winter, 2002).

Consequently, in the second round, we challenge participants to cope with an exogenous shock and adjust their existing routines — a longitudinal perspective to capture dynamic capabilities (Wollersheim & Heimeriks, 2016). While the other rules and elements of the game remain the same, it is important to highlight that the change is not trivial. Even if a given configuration of cards appears in both

rounds, and the participants remember the exact moves used previously, they cannot solve the hand by repeating them[4].

3.3 Sample and incentives

We determined the target sample size with the support of the G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007). Considering the following parameters: effect size f = 0.40, α err prob = 0.05, power (1 − β err prob) = 0.80, numerator DF = 1 and number of groups = 4, G*Power indicated a sample size of 64 observations. Accordingly, we collected observations from 80 teams. This sample size provided a safety margin for potential observations discarded that could reduce the final sample without inflating the likelihood of "false" significant results. Moreover, this sample size is in line with previous research in management on this topic (e.g. Levine, Bernard, & Nagel, 2017).

We recruited graduated students in management only in the pilot studies to refine the experimental design[5]. The sample analyzed in this study includes only Brazilian participants with managerial experience leading a team, either as corporate executives or entrepreneurs, which is particularly important considering that most recent experimental studies in strategic management are conducted with students (e.g. Håkonsson et al., 2016). Further, to choose participants from one country (Brazil) reduces potential cross-country effects.

Similar to Laureiro-Martínez and Brusoni (2018), we offered both monetary incentives (variable remuneration based on task performance) and nonmonetary incentives (a detailed report comparing personal performance with the group average) in exchange for executive participation. The remuneration system designed by Cohen and Bacdayan (1994) is a function of one dollar per hand completed, less ten cents per move required to put the 2♥ or the 2♣ in the target position. Thus, participants must "play quickly in order to increase the hand number

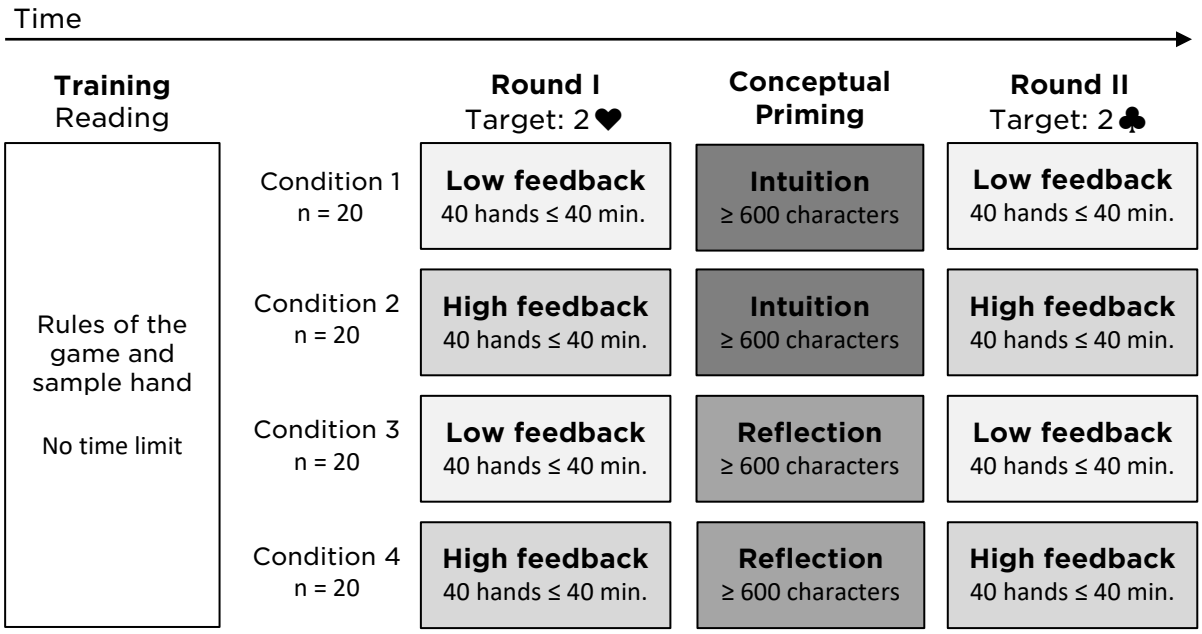
[4] A detailed description of the experimental task can be found in Cohen and Bacdayan (1994).
[5] We found failures in the software interface and in the training instructions.

of hands completed" and "to play carefully in order to avoid unnecessary moves in completing each hand" (Cohen & Bacdayan, 1994, p. 560).

3.4 Research Design

To provide robust evidence while testing our predictions, we follow the best practices in randomized controlled trials (RCTs). First, participants were randomly assigned—without their knowledge—to one of four experimental conditions in a between-subjects factorial design: 2 (cognitive processing, Intuition versus Reflection) × 2 (feedback opportunity, High versus Low). Specifically, we adopted a randomized block design to keep the same number of observations in each condition (i.e. 20 teams), therefore, participants were randomly assigned within each experimental condition (Urbaniak & Plous, 2013). Second, we employed a triple-blind experimental design to reduced assessment bias. Thus, (1) the decision-makers participants, (2) the researcher assistants who administer the task, and (3) the researcher who analyzed the data were not aware of the treatments (Dawes, 2010). **Figure 8** summarizes the overall design of the experiment.

Figure 8 – Experimental Design



During the training phase, as suggested by Goodman et al., (2013), the initial introduction contextualized the participants of the game in terms of general background, procedure and incentive structure. Then, they engaged in the training which includes a written explanation of the rules of the game and a sample hand, which illustrated the rules of the game. The computerized training will be followed by a short question-and-answer session, according to the participants' demand.

Next, participants were randomly allocated to partners which were being assigned to the four experimental conditions of the study: (i) Intuition and Low feedback, (i) Intuition and High feedback, (i) Reflection and Low feedback and, (i) Reflection and High feedback. Essentially, participants follow the experimental task as described in Section 3.2. Thus, all participants had to play two rounds of 40 hands, with the conceptual priming between then. By last, participants were required to answer a questionnaire for additional information.

3.4.1 Manipulation 1: cognitive processing

We manipulate cognitive processing using a conceptual prime well-established in previous research with economic games (Rand, Greene, & Nowak, 2012). This manipulation adapted the 10-minute break from the original study of Cohen and Bacdayan (1994). After completion of the first round, we ask the participants to write at least 600 characters recollecting a situation in which their intuition led to a positive outcome or reflection led them to a negative one (both promoting intuition); or the opposite (both promoting reflection). Thus, we counterbalanced valence with both positive and negative outcomes in each of our two conditions. **Table 5** shows the conceptual priming for each treatment and valence.

Table 5 – Conceptual priming for cognitive processing manipulation

Manipulation	Conceptual Priming
Intuition (Positive)	"A recent study has shown evidence that people who make decisions based on their intuition/first instinct in their daily life would result in a more successful life in that they have a more desirable relationship with people around, higher salary and higher social status. Please write a paragraph (approximately 8-10 sentences) describing a time your intuition/first instinct led you in the right direction and resulted in a good outcome."
Reflection (Negative)	"A recent study has shown evidence that people who make decisions based on their intuition/first instinct in their daily life would result in a more successful life in that they have a more desirable relationship with people around, higher salary and higher social status. Please write a paragraph (approximately 8-10 sentences) describing a time carefully reasoning through a situation led you in the wrong direction and resulted in a bad outcome."
Reflection (Positive)	"A recent study has shown evidence that people who make decisions based on their reflection/careful reasoning in their daily life would result in a more successful life in that they have a more desirable relationship with people around, higher salary and higher social status. Please write a paragraph (approximately 8-10 sentences) describing a time carefully reasoning through a situation led you in the right direction and resulted in a good outcome."
Intuition (Negative)	"A recent study has shown evidence that people who make decisions based on their reflection/careful reasoning in their daily life would result in a more successful life in that they have a more desirable relationship with people around, higher salary and higher social status.

> Please write a paragraph (approximately 8-10 sentences) describing a time your intuition/first instinct led you in the wrong direction and resulted in a bad outcome."

3.4.2 Manipulation 2: feedback opportunity

Feedback opportunity was manipulated by varying how much information participants have about their performance (Goodman, Wood & Hendrickx, 2004). In the Low feedback condition, identical to the original card game, the participants were informed about the (1) hand number, (2) total elapsed time, and (3) number of moves in the hand. In the High feedback condition, as participants move the cards, they were also informed about how far they are from the optimal solution, that is, the minimum number of moves to solve that hand.

It is important to highlight that both groups are subjected to the same rules for remuneration, which are informed before the task starts, the difference between the conditions is the knowledge on the effect of each participant action on the game performance. Thus, we increased the amount of information available regarding the task performed (Goodman, Wood & Hendrickx, 2004). Unlike cognitive processing manipulation, this manipulation is constant across the rounds. Thus, participants play both rounds under the High or the Low feedback treatment, not only after novelty introduction before the second round.

3.5 Measures

Table 6 exhibits the main variables of the study. Our explanatory variables—cognitive processing and feedback opportunity—are directly measured by the groups' manipulation (Section 3.4), which allocated individuals to groups with different treatments. Thus, each variable is a dummy indicating the category of the treatment. The outcome variable, dynamic capabilities, we measure with the team performance after novelty manipulation.

Table 6 – Variables of the study

Variable	Cognitive Processing	Feedback Opportunity	Dynamic Capabilities
Type	Explanatory variable	Explanatory variable	Outcome variable
Definition	Mode of thinking engaged during a specific activity or situation.	Level of information provided to decision-makers to understand which actions were appropriate or not.	Firm ability to adjust their routines to cope with an exogenous shock.
Operationalization	Experimental manipulation (Intuition vs. Reflection)	Experimental manipulation (High vs. Low)	Performance after novelty manipulation
Reference	Rand et al. (2012)	Goodman et al. (2004)	Wollersheim and Heimeriks (2016)

To measure dynamic capabilities is a challenge since its conceptualization (Wilden et al., 2016). Despite the growing literature, the measures available are not suitable for a laboratory setting. Following Wollersheim and Heimeriks (2016), we measured our dependent variable—dynamic capabilities—by the money gained in the second round (i.e. after novelty manipulation)[6]. Specifically, dynamic capabilities level is a function of one dollar per completed hand less ten cents per moved needed to put the 2♣ in the target position. This measure captures the capacity of adjusting existing operational routines subsequent to an environmental change – novelty manipulation (Wollersheim & Heimeriks, 2016). In this sense, dynamic capabilities are measured from the effects attributed to them.

[6] Another four dimensions of routine development from the experiment: (1) repetitiveness in action, (2) speed in action, (3) reliability in action, and (4) attentiveness in action (Cohen & Bacdayan, 1994; Wollersheim & Heimeriks, 2016).

Unlike real competitive markets, performance in the game can only be attributed to the participants' ability to adjust their routines to cope with environmental change. For instance, participants must make better use of the resources (i.e. fewer moves) and increase the efficiency of coordination in their actions to increase performance (Cohen & Bacdayan, 1994; Garapin & Hollard, 1999). Accordingly, this experimental measure excels existing ones in the literature because: (1) it is a measure of process improvement; (2) money gained is entirely a result of participants behavior; (3) the measure occurs only after novelty manipulation; (4) and performance is not subjected to self-evaluation (Wollersheim & Heimeriks, 2016). Further, this measure is consistent with our conceptual definition of dynamic capabilities (Zollo & Winter, 2002) and it addresses the critiques of tautology from the field (Schilke, Hu, & Helfat, 2018).

In addition, we collected a number of extra information as shown in **Table 7**. First, we collected demographic variables in the final questionnaire to describe our sample. Second, we gathered specific information to guarantee that the manipulations conducted were effective. Third, we checked the participants' attentiveness to make sure they do not fail to follow instructions, which could increase the noise and decreases the validity of data collected. Fourth, we collected some measures to evaluate alternative mechanisms potentially influencing observed patterns in the experiment.

Table 7 – Additional measures collected

Type	Measures
Demographic characteristics	❖ Position in the firm (entrepreneurs or corporate executive) ❖ Years of formal education ❖ Years of working experience ❖ Number of employees directly led/supervised ❖ Company size (numbers employees) ❖ Industry dynamism (Likert 1-5) ❖ Frequency of decisions that affect firm performance (Likert 1-5)
Manipulation checks	❖ Cognitive Reflection Test (Frederick, 2005) ❖ Speed: average number of seconds per move (Rand et al., 2012) ❖ Perception of information provided as useful (Brockner et al., 1986) ❖ Perception of performance (Cianci, Klein, & Seijts, 2010)
Attentiveness check	❖ Diligent behavior in reading and following instructions (Oppenheimer, Meyvis, & Davidenko, 2009)
Alternative mechanisms	❖ Paragraph length of the conceptual priming manipulation (Rand et al., 2012) ❖ Time reading the instructions (Rand et al., 2012) ❖ Experience with card/computer/video/smartphone games (Laureiro - Martínez & Brusoni, 2018) ❖ Risk propensity (Dohmen et al., 2011) ❖ Overconfidence (Cain, Moore, & Haran, 2015)

Note. Following Behling and Law (2000), every item or instruction originally in English was translated into Portuguese by a professional service (forward translation). Then, a professional service translated the Portuguese version into English (back-translation). Finally, a bilingual expert compared both versions and prepared the final version.

3.6 Data analysis

Similar to previous experimental studies (Cohen & Bacdayan, 1994; Wollersheim & Heimeriks, 2016), we draw on linear models to analyze the data collected. The analysis of variance (ANOVA) is particularly popular because it is robust to minor violations of assumptions (Kline, 2009) and yields a high statistical power with equal group sizes (Noguchi, Gel, Brunner, & Konietschke, 2012). With the support of the software Stata 15/MP Mac, our data analysis protocol followed four steps: (i) sample profile, (ii) manipulations check, (iii) experimental results and (iv) posthoc analysis. In the first step, we used descriptive statistics to characterize the sample of participants. Next, in the second, we compared means across treatment groups using one-way ANOVA to test the effectiveness of manipulations conducted. Then, we test our hypothesis with the two-way ANOVA, which can describe with Equation 1:

$$(1)\ y_{ijk} = \mu + \tau_i + \gamma_j + \beta_{ij} + \varepsilon_{ijk}$$

where y_{ijk} represents the team' second-round performance, μ represents the overall average second-round performance across all teams, τ_i represents the cognitive processing-specific effect on performance and γ_j represents the feedback opportunity-specific effect, β_{ij} represents an interaction term between these two effects and, ε_{ijk} represents the error term associated with that team. Finally, to ensure the robustness of our results, we took advantage of *t*-tests and ordinary least squares regressions to evaluate sample bias, the experiment design quality and individual-level effects on manipulations.

4. FINDINGS

4.1 Sample profile

We recruited only full-time employed decision-makers with managerial experience in leading a team, either as corporate executives or entrepreneurs, to participate in our lab experiment. More specifically, our sample comprises decision-makers with comparable characteristics: (1) they have working experience between 5 and 17 years, (2) they have an MBA degree or at least are engaged in an MBA program, (3) they lead groups with two members or more and, (4) in general, they make decisions that can affect firm performance frequently. **Table 8** displays the main characteristics of the sample.

Table 8 – Descriptive statistics of the sample

Characteristics	Mean	SD	Min.	Max.
% Entrepreneurs	22.50	–	0	1
Years of formal education	18.52	1.62	16	21
Working experience	10.75	3.64	5	17
Number of employees directly led/supervised	15.90	9.82	2	50
% Company size > 100 employees	70%	–	0	1
Industry dynamism (Likert 1-5)	3.87	0.97	1	5
Frequency of decisions that affect firm performance (Likert 1-5)	3.56	0.70	2	5

Note. n = 160.

While we do not have particular reasons to expect different results from workers in non-managerial positions, we purposefully targeted a sample within our theoretical domain and comparable with previous research on cognitive processing in the management literature (e.g. Laureiro-Martínez et al., 2015).

4.2 Manipulations Check

First, to examine the effectiveness of cognitive processing manipulation, we applied the Cognitive Reflection Test – CRT (Frederick, 2005) and computed the speed in the second round (Laureiro-Martínez & Brusoni, 2018). In the Reflection condition (M = 2.38, SD = 0.67), teams scored higher on CRT than participants in the Intuition condition (M = 1.73, SD = 1.09; $F(1)78 = 10.40$, $p = .002$, $\eta_p^2 = .118$).

Also, as expected, teams in the Intuition condition (M = 18.09, SD = 3.79) were faster than participants in the Reflection condition (M = 22.85, SD = 3.50; $F(1)78 = 34.06$, $p < .001$, $\eta_p^2 = .304$). No other effects were found. This result suggests that cognitive processing manipulation was successful. To add some qualitative evidence in order to support the manipulation check, we selected some excerpts that do not disclose personal information from the essays (**Table 9**).

Table 9 – Excerpts from the cognitive processing manipulation

Priming Type	Excerpts
Intuition (Positive)	"At various times in my life I have had to make sudden decisions, it is when we are under pressure or risk, as well as when you are driving and have to decide to brake or run down a pet in the street, or even less important decisions like when I chose the salad sauce in hurry because of the long line I fell in love with it. Once I was driving, when I had just taken my CNH and it was necessary for me to move in the "wrong" side of the road, because there was a dog on the way trying to cross, I had to make a fast decision with risk for me and the dog, but the decision made resulted in no accident or damage to the animal."

Reflection (Negative)	"When it comes to unpredictable things and probabilities, it is never a good idea to use rationalism only. Once I decided not to install the temporary roofing for an event because the weather forecast and all other weather tools ensured that it would not rain, despite my intuition tell me that it would rain. It rained a lot and we lost more than R$ 20.000,00 with that. The point is when you make a mistake based on a rational decision you have a justification. That means, I can justify R$ 20.000,00 in damages for relying on a weather tool, but I could not say that I reduced R$ 1.000,00 the profits of the project to install the temporary roofing following my intuition."
Reflection (Positive)	"During a job presentation with my team I was asked something that I didn't know the answer and none of my team members could answer either. In this way, I divert the attention of the clients to have time to think properly. I analyzed the question and I tried to think in broader terms instead of exactly the context of our product application at that time. Then, I alluded to a practical situation I had experienced in my former company. With my reaction I added a point to the discussion and turned my attention to the root question later, reconnecting with the initial question, thus, I was able to train my ability to reason."
Intuition (Negative)	"Last year I participated in the organization of an event. My intuition said that everything would work out, that we were going to make a lot of money with the event, due to the good cost-benefit. Based on that, we had a big party, invested in location and great attractions, spending a lot of money before sales even started. Eventually, time went by, invitations were not sold, demand was too low, and I realized that my intuition had failed. The party had to be canceled, everything that had been paid before became a loss we had to bear, all because we had a feeling it would work."

Note. Excerpts translated from Portuguese-BR to English by the author.

Second, the feedback opportunity manipulation check measured the extent to which participants received useful information using a single-item measure: 'I understood how my decisions affected my game performance' (Brockner et al., 1986; Goodman, Wood, & Hendrickx, 2004). The results indicate that teams in the High feedback condition (M = 3.69, SD = 1.04) were more likely to report that they received useful information than teams in the Low feedback condition (M = 2.44, SD = 1.10; $F(1)78 = 27.25$, $p < .001$, $\eta_p^2 = .259$). No other effects were found. We can conclude that the manipulation of feedback opportunity was also successful.

It is important to note that while we present here the manipulation checks averaged at the team-level because the outcome investigated is at this level, our results from the manipulation checks at the individual-level are qualitatively the same.

4.3 Experimental Results

We examined the team's performance after the shock to determine the relative effect of cognitive processing (Intuition, Reflection) by feedback opportunity (High, Low) on routinized behavior adaptation. Data were screened for ANOVA assumptions (linearity, homogeneity, normality, outliers) and no concerns were found. The homogeneity of variances was confirmed with Levene's test ($F(3,76) = 0.57$, $p = .637$). Accordingly, we proceed to the analysis.

Table 10 shows the performance across by treatment. A 2x2 between subjects' ANOVA was analyzed on cognitive processing and feedback opportunity. The main effect of cognitive processing on performance was significant, showing that teams assigned to the Intuition condition (M = 28.35, SD = 0.93) were more likely to perform better than teams assigned to the Reflection condition (M = 26.82, SD = 1.51; $F(1,76) = 52.55$, $p < .001$, $\eta_p^2 = .409$). This supports our Hypothesis 1—intuitive cognitive processing over reflection increases dynamic capabilities.

Also, the main effect of feedback on performance was significant: teams in the High feedback condition (M = 28.28, SD = 0.95) were more likely to perform better than teams assigned to the Low feedback condition (M = 26.89, SD = 1.57; $F(1,76) = 43.08$, $p < .001$, $\eta_p^2 = .362$). Accordingly, the results provide support to Hypothesis 2— higher feedback opportunity (vs. lower) increases dynamic capabilities.

Moreover, these main effects were qualified by a significant interaction between cognitive processing and feedback, $F(1,76) = 18.12$, $p < .001$, $\eta_p^2 = .193$.

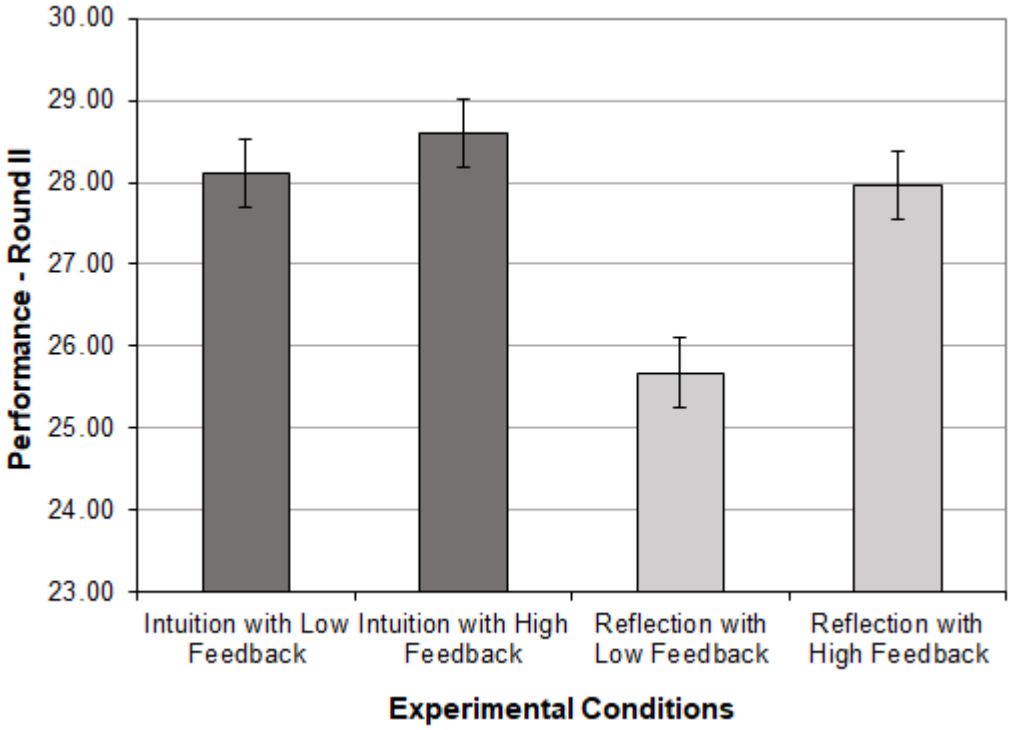
Table 10 – Performance Measures by Treatment

Treatment	Round I	Round II	Total	Δ%
Intuition	23.59 (1.16)	28.35 (0.93)	51.94 (1.53)	20.47 (6.92)
Reflection	23.50 (1.14)	26.82 (1.51)	50.32 (2.23)	14.28 (6.63)
High feedback	24.04 (1.07)	28.28 (0.95)	52.32 (1.46)	17.88 (6.47)
Low feedback	23.05 (1.01)	26.89 (1.57)	49.95 (1.91)	16.88 (8.32)

Note. Standard deviation of the mean in parentheses.

Supported by the significant interaction term, we ran a series of planned comparisons to test Hypothesis 3. The results indicate that teams with Low feedback perform significantly better in the Intuition condition ($M = 28.11$, $SD = 0.88$) than in the Reflection condition ($M = 25.68$, $SD = 1.07$; $F(1,38) = 61.42$, $p < .001$, $\eta_p^2 = .618$). Conversely, teams with High feedback perform only slightly better in the Intuition condition ($M = 28.60$, $SD = .93$) than in the Reflection condition ($M = 27.96$, $SD = .88$; $F(1,38) = 4.85$, $p = .034$, $\eta_p^2 = .113$). This provides support for Hypothesis 3—when teams use intuition instead of reflection with low feedback opportunity ($\Delta = 2.43$), versus teams with high feedback ($\Delta = 0.63$), they exhibit a higher level of dynamic capabilities. **Figure 9** summarizes the results presenting the marginal effects of the 2x2 between subjects' ANOVA, that is, the expected performance after shock for each treatment.

Figure 9 – Marginal Effects on Performance After Shock



Note: adjusted predictions with 95% CIs.

4.4 Post-Hoc Analysis

In order to qualify our findings, we ran additional analyses. First, to alleviate concerns with sample bias (i.e. survivorship bias), we collected and compared the demographic variables of the nonrespondents to the respondents (Di Stefano et al., 2015). Nonrespondents include individuals that either declined the invitation to participate in the study, failed to complete the experimental tasks or failed in the attentiveness check (Oppenheimer et al., 2009). Their performance data was not recorded. Accordingly, the sample of respondents is slightly younger (32.10 vs. 32.75), has more years of study (18.52 vs. 17.67), and presents a smaller proportion of females (0.47 vs. 0.52) than the nonrespondents (**Table 11**). Considering the small differences, our results seem to be generalizable to the target population but more applicable to people with higher levels of formal education.

Table 11 – Individual-level differences between nonrespondents and respondents

Variables	Nonrespondents	Respondents	*T*-tests
Age	32.75	32.10	$t(235) = 1.05$, $p = 0.296$
Years of formal education	17.68	18.52	$t(235) = -4.19$, $p < .001$
Sex (female)	0.52	0.47	$t(235) = 0.73$, $p = 0.467$
Observations	77	160	

Second, we evaluated the experimental process. We test whether the groups assigned to the cognitive processing/feedback conditions differ in their performance in the first round. Prior to cognitive processing manipulation, groups in the Intuition condition (M = 23.59, SD = 1.16) did not differ from the ones in the Reflection condition (M = 23.50, SD = 1.14) in their performance during the first round ($t(78) = -0.35$, $p = .728$).

Consistent with experimental design, groups in the High feedback condition (M = 24.04, SD = 1.07) indeed performed better than the ones in the Low feedback condition (M = 23.05, SD = 1.01) in the first round ($t(78) = -4.23$, $p < .001$). Thus, we capture the effects of the treatments only after the manipulation, endorsing causal effects claims underlying our experimental design.

We also examined if the effect of promoting intuition versus reflection differed based on the outcome valence positive or negative (Rand et al., 2012). Model 4 in **Table 12** shows no significant interaction between the cognitive processing dummy and the outcome valence dummy ($\beta = -0.063$, $p = 0.833$). Further, paragraph length and time reading the instructions were not statistically significant, in line with previous studies with similar design (Rand et al., 2012).

In addition, to ensure the robustness of the experimental process, a trained psychologist (B.S., M.Sc.) examined the textual content of the conceptual prime to check if the manipulation was appropriate.

Table 12 – Explaining performance after novelty manipulation

Variables	Model 1	Model 2	Model 3	Model 4
Cognitive processing (intuition)		1.562***	2.421***	2.452***
		(0.233)	(0.313)	(0.371)
Feedback opportunity (high)		1.312***	2.209***	2.207***
		(0.232)	(0.308)	(0.310)
Cognitive processing × feedback opportunity			−1.738***	−1.737***
			(0.428)	(0.430)
Cognitive processing × outcome valence				−0.063
				(0.296)
Paragraph length	−3.48e-4	2.71e-4	2.52e-4	2.29e-4
	(1.25e-3)	(9.63e-4)	(8.82e-4)	(8.94e-4)
Time reading	0.179*	0.115	0.074	0.076
	(0.100)	(0.074)	(0.064)	(0.065)
Intercept	27.47***	25.67***	25.34***	25.35***
	(1.078)	(0.785)	(0.713)	(0.719)
Observations	80	80	80	80
F-test	1.67	18.41***	20.96***	17.40***
Adjusted R-squared	0.01	0.49	0.58	0.57

Note. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Third, we verified whether individual-level characteristics could explain the manipulations. We collected these data via questionnaire after the completion of the game. We checked for means differences in terms of sex (Laureiro-Martinez, 2014), age (Laureiro-Martinez, Trujillo, & Unda, 2017), risk preferences (Dohmen et al., 2011), overconfidence (Cain et al., 2015), and experience with computer/video/smartphone games or playing cards (Laureiro-Martínez & Brusoni, 2018). Our results showed that participants in the Intuition versus Reflection conditions (**Table 13**) or in the Low versus High feedback opportunity conditions (**Table 14**) do not differ in any of these characteristics, except sex.

Table 13 – Individual-level differences in cognitive processing manipulation

Variables	Intuition	Reflection	*T*-tests
Sex (female)	0.46	0.48	$t(158) = 0.16$, $p = 0.875$
Age	31.66	32.54	$t(158) = 1.31$, $p = 0.191$
Risk preference	7.00	6.76	$t(158) = -0.74$, $p = 0.191$
Overconfidence	1.05	0.98	$t(158) = -1.69$, $p = 0.093$
Game experience	2.84	2.90	$t(158) = 0.28$, $p = 0.780$

Table 14 – Individual-level differences in feedback opportunity manipulation

Variables	Low feedback	High Feedback	*T*-tests
Sex (female)	0.57	0.36	$t(158) = 2.73$, $p = 0.007$
Age	32.38	31.83	$t(158) = 0.82$, $p = 0.412$
Risk preference	6.71	7.05	$t(158) = -1.05$, $p = 0.294$
Overconfidence	0.99	1.03	$t(158) = -0.94$, $p = 0.347$
Game experience	2.99	2.75	$t(158) = 1.07$, $p = 0.287$

In the feedback opportunity manipulation, there was a larger proportion of females in the Low feedback condition than in the High (0.57 versus 0.36, respectively). Since previous literature suggests that women might differ from men in terms of competitive/cooperative behavior (Laureiro-Martinez, 2014), one could argue that sex differences in group composition explain the results rather than the feedback manipulation. Thus, we compared the feedback manipulation check within each condition between males and females: we found that they did not respond differently from each other either in the Low ($t(78) = -0.33$, $p = 0.743$) or in the High feedback conditions ($t(78) = -0.43$, $p = 0.666$). Therefore, we trust our results are robust.

5. DISCUSSION

5.1 Contributions of the study

Overall, our study offers several contributions to the existing literature. First, we contribute to the microfoundations of strategy by revealing the interplay of cognitive modes (intuition and reflection) in dynamic capabilities (Laureiro-Martinez, 2014). To date, there is a very small number of studies examining intuition in teams (Akinci & Sadler-Smith, 2012) and even less in the context of dynamic capabilities (Hodgkinson & Healey, 2011).

Accordingly, our results dialogue directly to the aggregation of micro-level elements into macro-level ones: while previous research suggests the advantage of reflection in individual decision-making (Levine et al., 2017), we show that priming intuition yields superior performance for collective entities, such as organizational routines, in the context of strategic change. Precisely, we show the high value of intuitive cognitive processing for dynamic capabilities is conditional to more turbulent environments (Dane & Pratt, 2007). This represents not only a shift in the understanding of intuition/reflection in management, but also accounts the role of cognition in a more comprehensive view of firms' adaptation than prior research focused on decision-making (e.g. Laureiro-Martínez et al., 2015).

Individual decision-making is a central part of managerial activities during strategic change; however, it is insufficient if firms cannot adjust their routines to deploy specific resources. Thus, we explain the role of cognition in a different element of strategic change—firm routines instead of individual decisions—, and this element might be more pervasive than others. Considering the Penrosian model of rent generation and firm adaptation, firms can only make profits either by changing existing routines[7] dedicated to current resources or adjusting/extending these routines to new resources (Penrose, 1959). However, firm adaptation might occurs without central decision-making processes where adaptation is emergent, bottom-

[7] Penrose (1959) uses the term 'services' rather than 'routines'.

up, granular and/or cumulative (Helfat & Winter, 2011; Ocasio, 1997; Shepherd, Mcmullen, & Ocasio, 2017; Wei, Yi, & Yuan, 2011).

Beyond the aggregational dimension, our results also stress the importance to take into account the time dimension when capabilities and firm evolution are investigated (Helfat & Peteraf, 2003). To date, most studies do not capture and analyze the longitudinal aspect of dynamic capabilities (Schilke, Hu, & Helfat, 2018). In this sense, considering the life cycle of capabilities at the micro-level, our results offer an interesting contrast with Di Stefano et al. (2016): while their study shows the superiority of reflection for capability creation (learning something new), ours demonstrates the superiority of intuition for capability adaptation (changing something you learnt). This suggests a contingency approach to cognitive processing on capabilities over time.

Second, we add a different layer in the understanding of environmental dynamism. Indeed, environmental dynamism has been one of the key variables investigated within the dynamic capabilities' framework (Schilke et al., 2018). The most acknowledged studies have examined whether dynamic capabilities are more valuable or not in environments more turbulent, based on measures of financial variability (e.g. Schilke, 2014). However, environmental dynamism differs along different dimensions, such as direction, magnitude, and frequency of change (Stieglitz, Knudsen, & Becker, 2016).

Considering that learning processes lie at the heart of the dynamic capabilities' framework (Zollo & Winter, 2002), we considered environment dynamism as a reduction in the feedback on how strategic actions impact performance outcomes. Therefore, lower feedback opportunity affects the firm ability of updating information and adjusting their routines to cope with the environment (Lee & Puranam, 2016; Nadkarni & Chen, 2014). This is in line with a behavioral perspective on dynamic capabilities: stable and turbulent environments differ in the degree which they provide feedback opportunities for learning (Lee & Puranam, 2016; Puranam, Stieglitz, Osman, & Pillutla, 2015).

Third, our study provides new insights on one of the most debated topics in the literature on dynamic capabilities: the role of environmental dynamism on firm adaptation (Schilke, 2014). The literature has been divided among those who argue that dynamic capabilities drive change in high-turbulent environments (Teece et al., 1997) and those who argue that such environments do not have space for

learning and routine development (Eisenhardt & Martin, 2000). Because we examine the causal chain of macro-micro-macro elements of our framework, we can add to this discussion.

We support the claim from Eisenhardt and Martin (2000) that firm adaptation is facilitated in less turbulent environments, however, we show how firms can address strategic change when environmental dynamism is high. Intuition has a pivoting role in this regard. Accordingly, our answer lies at the co-evolution of external and internal forces that shape dynamic capabilities along the time (Jacobides & Winter, 2005). Routine adaptation to cope with a major environment shift is more challenge in a high-turbulent industry, however, managers intuition helps them to develop a sense of what should be adjusted. These moves back and forward of content between routinized tasks and managers cognition are consistent with prior studies on the use of heuristics (Bingham & Eisenhardt, 2011). For instance, Bingham, Howell and Ott (2019) show how firms create dynamic capabilities for internationalization using managers heuristics originated from heterogeneous learning experiences.

Fourth, we do not intend to argue that firms must hire individuals with subjective preferences for intuition (reflection) because they are better (worst) to adjust their operating routines. Both forms are cognitive evolutionary adaptive responses to specific context stimuli (Evans, 2008): to illustrate, people do not rely on reflective processing to escape from a lion attack.

Hence, we conceptualize the use of intuition and reflection as a result of the organization's design. Rather than individual attributes, we depart from the view that cognition and organizational structure jointly affect routinized behavior. Tasks with different levels of cognitive loads or inductive approaches, time constraints and, ego depletion lead individuals to rely more on one processing mode (Rand, 2016; Zhong, 2011). This view is consistent with our experimental design and with past research in management (Gavetti, 2005; Peysakhovich & Rand, 2016) and cognitive sciences (Evans, Dillon, & Rand, 2015; Krajbich, Bartling, Hare, & Fehr, 2015). For instance, Peysakhovich and Rand (2016) display in a laboratory setting how organization design may increase individuals' willingness to show prosocial behavior (cooperation) through intuition. Thus, our research extends the recent stream of studies in the architecture of choice to strategic management (Peysakhovich & Rand, 2016; Thaler, Sunstein, & Balz, 2012).

Instead of the traditional wisdom of deal with decision biases by means of changing the mind of the decision-maker (Bazerman & Moore, 2013), the architecture of choice takes the responsibility for organizing the context in which individuals behave. In the same manner that organizational structures less hierarchical tend to produce better outcomes in terms of innovation (Foss, 2003), organizational design can prime intuitive or reflective cognitive processing to foster different levels of dynamic capabilities in terms of coping with the environment. Our study helps to build psychological foundations for organizational design; therefore, it may shape management practices to enhance dynamic capabilities development, an important progress in the field (Gavetti, 2005).

Fifth, we connect strategy and psychology by recovering the habit as a micro-level representation of routines (Cohen & Bacdayan, 1994; Winter, 2013). Whereas previous research attributed habits only to individuals, modern behavioral science recognizes a collective dimension in habits, therefore, useful to examine organizational routines (Hodgson & Knudsen, 2010).

Despite the relevance of routines in explaining organizational behavior, and more specific, dynamic capabilities, there is a dispute on which extent routines represent top management team activities (Augier & Teece, 2009; Teece, 2014). Consistent with the psychology research, habits embody behavioral dispositions to specific stimuli (Wood, 2017). This micro-level conceptualization allows us to examine a common cognitive dimension of routines across different levels of the hierarchy: not only in the participants of the experimental task (Cohen & Bacdayan, 1994), but possibly in the decisions patterns of managers across different organizations (Bertrand & Schoar, 2003), as well in employees performing their daily activities (Bapuji, Hora, & Saeed, 2012). Thus, it enhances the potential of generalization of our findings to account individual action in dynamic capabilities.

In addition, research to date remains nevertheless focused on mindful processes (i.e. reflection) versus less mindful-process (i.e. intuition and habits), which implies to treat habit as equivalent to any other less mindful-process (Levinthal & Rerup, 2006). Therefore, studies in management are missing the findings from research on habit in behavioral sciences that, for instance, distinguish habits from other unconscious processing system (Wood, 2017). Maybe even more important, these studies are neglecting routines at the micro-level (Cohen & Bacdayan, 1994). Accordingly, our theoretical development contributes to a better distinction among psychological elements operating during firm adaptation.

Sixth, we believe that the interdisciplinary premise of this study contributed to an overall deeper examination of a relevant managerial issue. Human activity is broader than any discipline, therefore, the search for answers limited within the boundaries of a single discipline is completely anti-scientific because it means to ignore pieces of evidence. For instance, change habits is the primary goal (and challenge) of the "Behavior Change for Good Initiative" which is funded with $100 million and count with a team of top scientists from different backgrounds (BCGI, 2019). Still, their first randomized controlled trial with 63,000 individuals fail in creating lasting exercise habits. This gives a sense of how big the challenge of changing routines is, how engaged other disciplines are in solving this challenge and how promising our findings look.

Following innovation literature, we do contend that research spanning disciplines is important to move management studies forward (Leahey, Beckman, & Stanko, 2017). In particular, we attribute to the cross-knowledge fertilization, our research design. The experiment helped to balance the evidence in prior research—based only on the co-occurrence of events—with the introduction of causal evidence (Schilke et al., 2018). Beyond the dynamic capabilities research, management research, in general, has been accused to produce theories that explain the past rather than predict the future, and in this front, our study contributes to the field with a theoretical framework causally accountable.

Finally, we contribute to reconnect the current knowledge frontier in management research to its foundations. The social-psychologist John Dewey (1922) suggested that human nature relies on three broad faculties: impulse, intelligence, and habit. His framework oriented much of how the behavioral theory of the firm accounts human action in organizations, such as the notion of bounded rationality in transaction cost economics and evolutionary theories (Cyert & March, 1963; Simon, 1947). Yet, a remarkable feature of the literature is that we still have limited insight into how these three elements operate together in organizations. In this research, we answer recent calls from the literature (Salvato & Vassolo, 2017; Winter, 2013) and provide an integrative examination of his framework: impulse (intuition), intelligence (reflection), and habits (routines). Therefore, we contribute to the cumulative knowledge perspective of management as science overall.

5.2 Limitations and future directions

Accordingly, a number of limitations need to be acknowledged, some of which suggest important avenues for future research. In this study, we conducted a lab experiment. While this methodological strategy is indicated for controlled theory testing and investigation of behavioral assumptions, future studies could adopt quasi-replication designs in order to contribute into building a cumulative body of knowledge (Bettis, Helfat, & Shaver, 2016). On the one hand, these studies could increase the robustness of our results and generate new insights into the mechanisms by using alternative methods, such as collecting data in the field. For example, Blanche and Cohendet (2019) took advantage of the ballet setting to understand routine transfer. Another noteworthy example in this sense is the study developed by Huang (2018) on investor gut feel: a dynamic expertise-based emotion-cognitions specific to the entrepreneurship context. She developed a qualitative investigation to generate a model of how investors elaborate on the intuiting process. An additional advantage of this strategy is to translate the laboratory setting to real-world managerial strategies to promote intuition for firm adaptation.

On the other hand, future studies could supplement our results by assessing the relative treatment effect sizes for specific contexts and, therefore, generalize our findings to new populations—capabilities, industry, countries, periods of time, etc (Highhouse, 2009; Rubinstein, 2001). As firms develop across time different types of dynamic capabilities (e.g. alliances, mergers, and product development), these capabilities mutually affect each other and differ in how they are routinized. For instance, in routines across organizations (Zollo, Reuer, & Singh, 2002), adaptation might be harder because there are routine triggers beyond the firm's boundaries. Also, in these inter-organizational settings, implicit stereotypes stemming from intuitive cognitive processing might reduce organizational change as suggested by research in management (Healey, Vuori, & Hodgkinson, 2015) and psychology (Greenwald et al., 2002).Going beyond context-specific differences, future research should investigate the emergence and aggregation of routine adaptation (Felin et al., 2015). The strategy field concerns mainly with collective concepts, therefore, the behavioral strategy should integrate individual and collective psychology to move forward (Powell et al., 2011).

Consistent with the role of decision-makers in managerial dynamic capabilities (Helfat & Peteraf, 2015), we depart from the view that individual behavior represents a reliable proxy for organizational behavior (King et al., 2010). Nevertheless, at least two challenges reside in this approach. The first one is mental scaling: "assuming that a firm or corporation has the psychology of an individual, that one person chooses for the collective, that the firm's actions correspond to a person's decisions, or that many individual choices sum to a collective choice" (Powell et al., 2011, p. 1374). Only in small, entrepreneurial, autocratic, or family-owned firms, it is possible to assume that CEO decisions reflect strategic organizational actions (Lovallo & Sibony, 2010). It is essential to embrace the heterogeneity in each level of the organizational (Felin et al., 2015). For instance, Foss, Lindenberg, and Weber (2019) suggest that different types of opportunistic behavior are more likely under different hierarchical forms.

The second challenge is directly connected with the discussion of aggregation in the microfoundation movement. Hence, to the extent that the processes of aggregation may not follow a linear pattern, future researchers should deeper our initial insights on how organizational design can change collective outputs via cognitive mechanisms and clarify the aggregation of heterogeneity through the levels of the organization (Felin et al., 2015). In terms of methodological challenges, econometric methods still have limited options to analyze bottom-up or micro→macro relationships as in our framework. While prior research has often used aggregated means of individual-level measure, we adopted group experimental treatments to overcome this limitation. Thus, future research would benefit of mix-methods endeavors or multilevel development of new techniques to understand the emergence and aggregation of phenomena across multiple levels of the organization.

Furthermore, we examined in this study a narrow definition of dynamic capabilities that emphasizes firm adaptation in response to an external shock (Zollo & Winter, 2002). Although somehow overlooked in the dynamic capabilities' literature, dynamic capabilities may operate shaping the environment— not just adapting to it (Teece, 2007; Zott, 2003). That is, organizations differ in which degree they are responding to market dynamics or endogenously seeking to adapt (Posen & Levinthal, 2012). In this sense, future research in this realm could take advantage of qualitative methods or computational models. While MacLean, MacIntosh, and Seidl (2015) suggest individual roots of purposeful adaptation relies on creativity,

to date, there is limited research on how cognition operates on the interplay between firm market-driven and market-driving change.

We consider this a major gap in the literature. Consequently, a promising path for the microfoundations of market-driving dynamic capabilities is to investigate entrepreneurial firms, which have been for a long time recognized as a source of market change (Schumpeter, 1934b). According to Teece (2007, p. 1321), the "element of dynamic capabilities that involves shaping (and not just adapting to) the environment is entrepreneurial in nature." Precisely, we suggest future studies to follow the judgment-based view that underscores the notion of entrepreneurship as a collective function of judgment to coordinate and deploy heterogeneous resources under uncertainty (Foss, Klein, Kor, & Mahoney, 2008).

This definition refines the scope of entrepreneurship in at least two ways. First, it shifts attention from opportunity discovery or creation to entrepreneurial judgment. Rather than pursuing opportunities that are defined just *ex-post* successful exploitation, judgment as unit of analysis represents the entrepreneurial behavior as the act of pursuing profits under conditions of uncertainty (McMullen & Dimov, 2013). Second, this definition emphasizes the institutional dimension of entrepreneurship. In this sense, there is no entrepreneurship without the responsibility and control of resources, such as assets and human capital (McMullen & Dimov, 2013). Consequently, this definition also removes from the scope of entrepreneurship the simply idea generation process: as Schumpeter (1947, p. 152) argued, "the inventor produces ideas, the entrepreneur 'gets things done'". The notion of judgment and collective creation could be mapped to the idea of cognition and capabilities in future research. We believe that connecting the judgment-based view of entrepreneurship (Foss & Klein, 2012) to the microfoundations movement (Felin et al., 2015) can provide a conceptual framework to understand how firms can create market change rather than just to adapt to external shocks.

Overall, notwithstanding the central role of learning in dynamic capabilities (Zollo & Winter, 2002), there are several promising paths to reveal the behavioral and cognitive underpinnings of dynamic capabilities.

6. CONCLUSION

How do organizations cope with environmental changes? The literature has increasingly acknowledged that the answer lies in the individuals and their patterns of interaction (Felin et al., 2012; Gavetti, 2005; Salvato & Vassolo, 2017; Winter, 2013). For instance, individual behavior is the primary explanation of processes such as efficiency organizational routines as well as the envisioning of new products or business models (Eggers & Kaplan, 2013; Parmigiani & Howard-Grenville, 2011). Moreover, dynamic capabilities are deeply rooted in decision-making activities based on individual skills (Teece, 2007). In this sense, the study of the individual cognition can reveal the underpinnings of organizational adaptation and change (Helfat & Peteraf, 2015).

We contribute to this line of inquiry by providing a micro-level account of firm adaptation. We examine a central topic in management research: dynamic capabilities—the firm ability to adjust their routines to cope with an exogenous shock (Zollo & Winter, 2002). In our theoretical framework, we follow previous research and consider routines as the expression of habits (Cohen, 2007; Hodgson & Knudsen, 2012). Further, supported by the dual-process theory of reasoning, we depart from the notion that the use of intuitive (fast and affective) or reflective (slow and analytic) cognitive processing affects group behavior (Peysakhovich & Rand, 2016). Therefore, we investigate how cognitive processing modes affect dynamic capabilities.

Aiming to provide causal evidence to illuminate this topic, we designed and conducted a lab experiment with experience managers, in which they developed routines and next were challenged to adapt them after an exogenous shock. In line with our first prediction, the empirical analyses showed a positive effect of priming intuition over reflection on dynamic capabilities. Likewise, we found that a higher level of feedback opportunity also has a positive impact on dynamic capabilities, as predicted. In addition, we tested and showed that dynamic capabilities are favor by intuition rather than the reflection in an environment exhibiting lower feedback (i.e. more dynamics), while in a higher feedback environment (i.e. more stable) the difference is small.

In conclusion, intuitive cognitive processing can indeed support dynamic capabilities, but it represents an advantage to the extent that the environment has limited opportunity for feedback.

Our research makes a novel contribution to in several ways. First, we answer the call for studies examining Dewey's (1922) triad of human nature in organizational adaptation (Salvato & Vassolo, 2017). Second, we show the effect of cognitive processing on collective outcomes (i.e. routine adaptation), which is not addressed in the dynamic capabilities' literature (Sanchez-Burks & Huy, 2009). Third, by employing an experimental method we help to rebalance the empirical evidence in the capabilities' literature focused on surveys and case studies (Schilke, Hu, & Helfat, 2018). Finally, and most importantly, our findings provide insights into the micro-level origins of dynamic capabilities and how to develop them. Thus, we provide the foundations for managers to design an architecture of choice based on cognitive elements underlying behavioral change. In sum, we advance current research on capabilities by shedding light on the cognitive underpinnings of firm adaptation.

"Despite widespread claims to the contrary, the human mind is not worse than rational… buy may often be better than rational" (Cosmides & Tooby, 1994, p. 329)

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