Intuitive learning and the evolution of dynamic capabilities

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with

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7th May, 2020

Organization Science Special Issue Conference

Main concerns of the reviewers

Comment	Revision
Framing: you should not use Dewey's (1922) notion of impulse (intuition), intelligence (reflection), and habits (routines) to investigate the microfoundations of dynamic capabilities.	We focused only on dynamic capabilities and dual-process cognition.
Theory: your theorizing of the links from feedback opportunity to dynamic capabilities is particularly weak.	We refined our conceptualization to "information availability" and we removed the initial H2.
Empirics: you should present additional tests to provide your readers with a better understanding of the micro-foundational behaviors behind your observations.	We conducted a series of additional post-hoc analysis.

Motivation

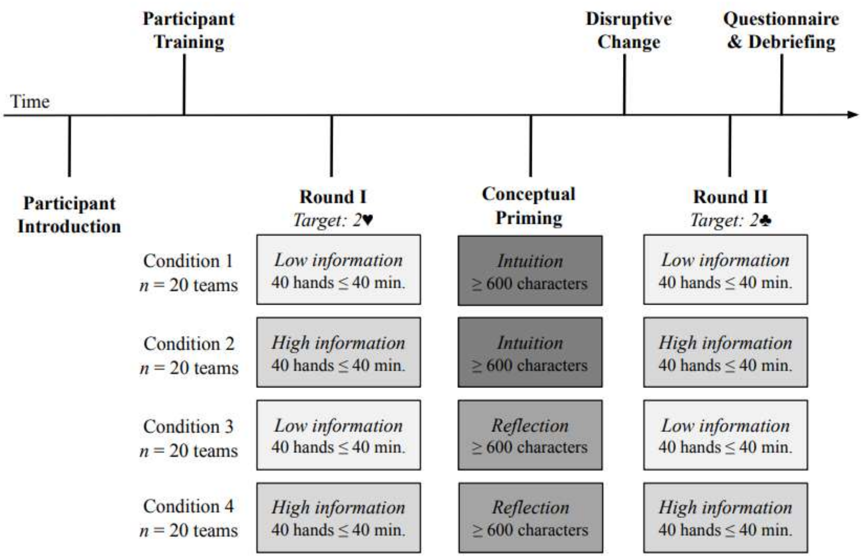
Dynamic capabilities are collective patterns of learning that drive firm adaptation (Helfat et al., 2007)

Cognition in dynamic capabilities (Hodgkinson and Healey, 2011):
- Intuition (Type 1 process) and reflection (Type 2 process) (Evans and Stanovich, 2013)

Environmental change might be disruptive, fast and unpredictable (Eisenhardt, Furr & Bingham, 2010)

RQ: What is the relative value of reflection vs. intuition on dynamic capabilities in face of disruptive changes?

Research Design

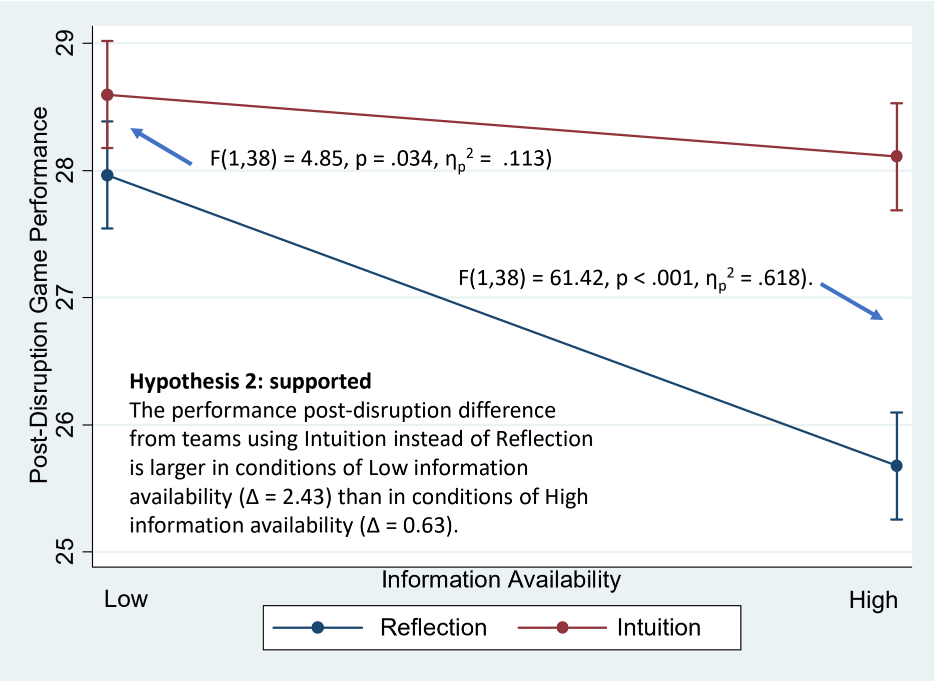


Experimental Task
Target the Two
(Cohen & Bacdayan, 1994)

- Behavioral experiment
- Collective activity
- Learning cycles
- Performance depends on fast and correct moves

Hypotheses Test

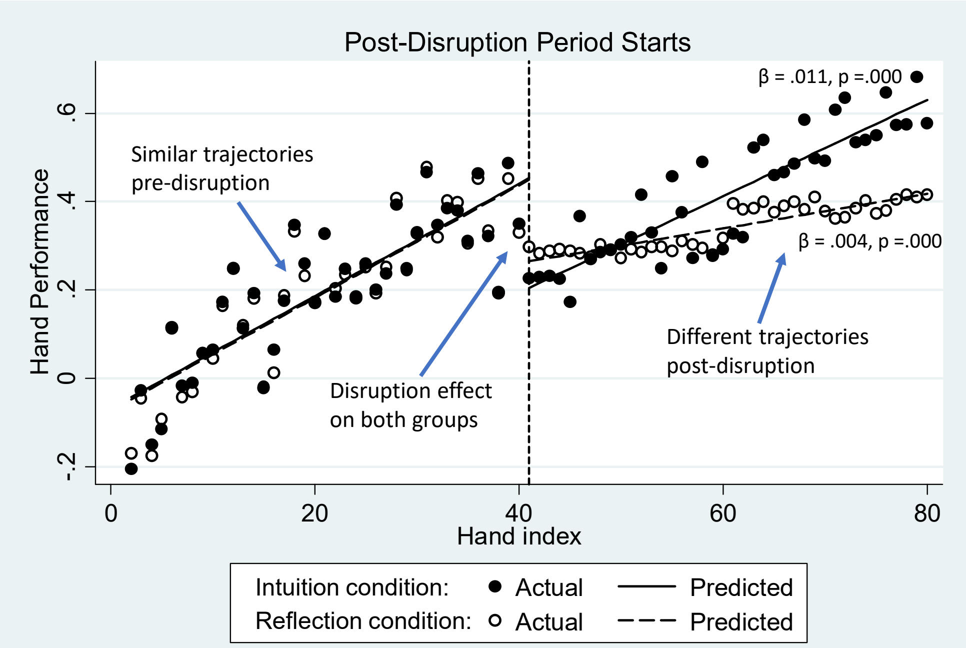
Hypothesis 1: supported
Teams assigned to Intuition condition (M = 28.35, SD = 0.93) were more likely to perform better post-disruption than teams assigned to the Reflection condition (M = 26.82, SD = 1.51; $F(1,76) = 52.55$, $p < .001$, $\eta_p^2 = .409$).



Interrupted time-series analysis

Short-term
No difference immediately following the disruption ($\beta = -.063$, $p = .316$).

Long-term
Intuition outperforms Reflection by 2.79 times for each additional round post-disruption ($\beta = .007$, $p = .038$).



Regression with Newey-West standard errors - lag(1)

Post hoc analysis

	Coordination	Deviance from Optimality	Routinization
Hypothesis 1: Cognitive Processing	Teams the Intuition condition ***decreased the number of moves per hand*** by approximately .11, while in they reduce by .04 in the Reflection condition (*p* = .000).	Teams the Intuition condition ***deviates*** 1.92 moves ***from optimal number of moves per hand***, while teams in the Reflection condition deviates 2.69 moves (*p* = .000).	Teams the Intuition condition ***repeats each pattern to finish a hand*** 3.00 times, while teams in the Reflection condition repeats 2.54 times (*p* = .000).
Hypothesis 2: Cognitive Processing x Information Availability	No differences found (p = .835)	The reduction of information availability more detrimental for the Reflection condition —from 2.12 to 3.26— than for the Intuition condition — from 1.80 to 2.04 (*p* = .000).	No differences found (p = .266).

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Linking Thought to Action in Dynamic Capabilities: A Micro-Level Inquiry into Firm Adaptation

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Abstract

A growing number of studies have connected cognitive capabilities to strategic change. However, the literature lacks an integrative investigation of the traditional triad of human faculties: impulse, intelligence, and habits. To fill this gap, we investigate dynamic capabilities mapping these faculties to intuition, reflection, and routines, respectively. To test our predictions, 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. In sum, our study contributes to providing a micro-level account of firms' dynamic capabilities.
Keywords: Dynamic Capabilities; Behavioral Strategy; Microfoundations; Cognition.

Acknowledgments

This study was conducted as part of the PhD thesis of the first author under the supervision of the third and fourth authors. The authors thank for the insightful comments at different stages of the study provided by Ashleigh Rosette, Daniel Levinthal, Gian Jesi, Glauber Santos, Libby Weber, Massimo Egidi, Peter McKiernan, Violina Rindova and Patrick Oehler. We also would like to thank the technical assistance of Octavio Crosara. The study benefited from a research visit by the first author to the Bocconi University during 2018-2019 supported by the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Finance Code 001.

1. Introduction

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, Foss, Heimeriks, & Madsen, 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).

According to Dewey (1922), people have three broad social-psychological faculties: impulse, intelligence, and habit. This framework oriented much of how the behavioral theory of the firm accounts human action in organizations, such as the notion of bounded rationality (Cyert & March, 1963; Simon, 1947). The literature suggests that intuition (i.e., impulse) lead to better firm investments during unpredictable market changes (Huang & Pearce, 2015); also that reflection (i.e., intelligence) allow firms to capture opportunities because they provide a better understanding of assets' true value (Levine, Bernard, & Nagel, 2017) and, further, that routinization (i.e., habits) has a central role for decision-making performance (Laureiro-Martinez, 2014). Overall, the extant research supports that heterogeneity in these faculties at the individual level contributes to the differential ability of organizations to adapt under conditions of change (Salvato & Vassolo, 2017).

Yet, a remarkable feature of the literature is that we still have limited insight into how these three elements operate together in organizations. In line with the recent interest in the microfoundations of capabilities, recurrent conceptual studies have advocated an integrative investigation of Dewey's framework (e.g. Cohen, 2007; Salvato & Vassolo, 2017; Winter, 2013). Still, research to date remains nevertheless focused on mindful processes (intelligence) versus less mindful-process (impulse and habit), which implies to treat habit as equivalent to any other less mindful-process (Levinthal & Rerup, 2006). Thus, 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 study addresses this gap.

To provide a micro-level account of firm adaptation consistent with Dewey (1922), 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). Thus, we follow previous research and consider routines as the expression of habits (Cohen, 2007; Hodgson & Knudsen, 2010). Further, we map the original Dewey's notion of impulse and intelligence to the current conceptualization of intuition and reflection, respectively (Evans, 2008). 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). Accordingly, by taking advantage of a lab experiment with executives, we answer the following question: how cognitive processing modes affect dynamic capabilities?

Our research makes a novel contribution to the literature 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.

2. Theory

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, Langan-Fox, & Sadler-Smith, 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, 2000). 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 (Hodgson & Knudsen, 2004;

Cohen & Bacdayan, 1994). 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).

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, 2016), 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 (Huang & Pearce, 2015; Dane & Pratt, 2007). 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, Fletcher, Marks, & Hine, 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.*

Equally important as the firm internal resources, it is the competitive context (Teece et al., 1997). Several studies have argued that environmental dynamism translated into a treat to competitive advantage by reducing the feedback-learning opportunities (Nadkarni & Narayanan, 2007; Nadkarni & Chen, 2014). 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; Puranam et al., 2015; Nadkarni & Chen, 2014). 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.*

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 weaken intuition effectiveness (Salas, Rosen, & DiazGranados, 2010). That is because the linkages underlying intuition does not represent reality accurately, as 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 are 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, shape 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.*

Hence, Figure 1 summarizes the above theoretical framework that 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 Foss, Heimeriks, Winter and Zollo (2012) and Salvato and Rerup (2011), we choose to conduct a behavioral lab experiment. An experimental design has a core advantage over other methods of providing cause-effect relationships and, therefore, high internal validity (Grant & Wall, 2009). In this sense, a laboratory-based design provided support to advance theory by isolating our theoretical mechanisms.

Insert Figure 1 about here.

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3. Method

3.1. 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 which 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 facedown, two cards lying faceup and one card with each participant. One of the cards lying faceup is in the target position. 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, while the other participant can only exchange if both cards share the same number. 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.

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). Accordingly, we induce participants to develop a routinized problem-solving behavior in the first round. Before the second round begins, and without prior warning, we informed participants a rule change: they should place the 2♣ in the target position (rather than 2♥) and reverse their roles. Thus, 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.

3.2. Participants and Incentives

We recruited only full-time employed decision-makers with managerial experience leading a team, either as corporate executives or entrepreneurs, to participate in our lab experiment. 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 affect firm performance frequently. We recruited graduated students in management only in the pilot studies to refine the experimental design. Similarly, to Laureiro-Martínez and Brusoni (2018), we offered both monetary incentive (variable remuneration based on task performance) and nonmonetary incentive (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 of hands completed" and "to play carefully in order to avoid unnecessary moves in completing each hand" (Cohen & Bacdayan, 1994, p. 560).

3.3. Research Design and Manipulations

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 2 summarizes the overall design of the experiment.

Insert Figure 2 about here.

We manipulate cognitive processing using a conceptual prime well-established in previous research with economic games (Rand, Greene, & Nowak, 2012). 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. 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. Thus, we increased the amount of information available regarding the task performed (Goodman, Wood & Hendrickx, 2004).

3.4. Variables

Table 1 exhibits the variables of the study. Our independent variables—cognitive processing and feedback opportunity—are directly measured by the groups' manipulation. 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). 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[1] (Schilke, Hu, & Helfat, 2018).

Insert Table 1 about here.

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4. Findings

4.1. Manipulations Check

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, teams scored higher on CRT than participants in the Intuition condition ($F(1)78 = 10.40$, $p = .002$, $\eta_p^2 = .118$). Also, as

[1] For a detailed discussion on the measure of dynamic capabilities using the Target the Two card game, see Wollersheim and Heimeriks (2016).

expected, teams in the Intuition condition were faster than participants in the Reflection condition ($F(1)78 = 34.06$, $p < .001$, $\eta_p^2 = 0.304$). No other effects were found. This result suggests that cognitive processing manipulation was successful. 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 et al., 2004). The results indicate that participants in the High feedback condition were more likely to report that they received useful information than participants in the Low feedback condition ($F(1)78 = 27.25$, $p < .001$, $\eta_p^2 = .259$). No other effects were found. We can conclude that the manipulation of feedback opportunity was also successful.

4.2. 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 2 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, $F(1,76) = 18.12$, $p < .001$, $\eta_p^2 = .193$.

Insert Table 2 about here.

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 3 summarizes the results presenting the marginal effects of the 2x2 between subjects' ANOVA, that is, the expected performance after shock for each treatment.

Insert Figure 3 about here.

4.3. Post-Hoc Analysis

In order to qualify our findings, we run additional analyses. First, we verified whether individual-level characteristics could explain our results. We collected these data via questionnaire after the completion of the game. We check for differences in terms of gender (Levine et al., 2017), age (Laureiro-Martinez, Trujillo, & Unda, 2017), risk preferences (Dohmen et al., 2011), overconfidence (Cain, Moore, & Haran, 2015), and experience with computer/video/smartphone games or playing cards (Laureiro-Martínez & Brusoni, 2018). Our results remained qualitatively the same, therefore, we trust our results are robust.

Second, we evaluated the experimental process. We test whether the groups assigned to the cognitive processing conditions differ in their performance in the first round (prior treatment). No significant differences were found. We also examined if the effect of promoting intuition versus reflection differs based on the outcome valence (Rand et al., 2012). The analysis shows no significant interaction between cognitive processing dummy and the outcome valence dummy (positive or negative). Further, time reading the instructions and paragraph length were not statistically significant (Rand et al., 2012). In addition, a psychologist (B.S., M.Sc.) examined the textual content of the conceptual prime to guarantee the manipulation was appropriate.

Third, to alleviate concerns with sample bias (i.e. survivorship bias), we collect and compare the demographic variables of the nonrespondents to the respondents (Di Stefano, King, & Verona, 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, Meyvis, & Davidenko, 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 larger proportion of males (0.53 vs. 0.48) than the nonrespondents. However, none of these differences is statistically significant, thus, our results seem to be generalizable to the target population.

5. Discussion

Dewey's (1922) framework impacted much of how transaction cost economics and evolutionary theories account human action throughout the behavioral theory of the firm. In this paper, 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). Accordingly, we investigate how cognitive processing modes (intuition and reflection) affect dynamic capabilities under different conditions of feedback opportunity. Aiming to provide causal evidence to test our hypothesis, we designed and conducted a lab experiment with experience managers where they developed routines and next were challenged to adapt them after an exogenous shock. In line with our first prediction, the empirical analyses show a positive effect of priming intuition over reflection on dynamic capabilities. Likewise, we find that a higher level of feedback opportunity also has a positive on dynamic capabilities, as predicted. Further, we test and show that dynamic capabilities are favor by intuition rather reflection in an environment exhibiting lower feedback (i.e. more dynamics), while in higher feedback environment (i.e. more stable) the difference is small. In sum, we advance current research on capabilities by shedding light on the cognitive underpinnings of firm adaptation.

5.1. Implications for Theory and Practice

Overall, our study offers four main contributions to the existing literature. First, we contribute to the microfoundations of strategy by revealing the interplay of cognitive modes 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 speak 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 renders superior performance for collective entities, such as organizational routines, in the context of strategic change. Moreover, we also show the high value of intuitive cognitive processing for dynamic capabilities is conditional to more turbulent environments (Dane & Pratt, 2007). Regarding the life cycle of capabilities at the micro-level, our results offers also a nice contrast with Di Stefano et al. (2014): their study shows the superiority of reflection for capability creation and ours shows the superiority of intuition for capability adaptation. This suggests a contingency approach to cognitive processing on capabilities over time.

Second, we bridge 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 the top management team activities (Augier & Teece, 2009; Teece, 2014). Consistent with the psychology research, habits represent 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 also in the managers decisions patterns across different companies (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.

Third, we do not intend to argue that firms must hire individuals with subjective preferences for intuition (reflection) are better (worst) to adjust their operating routines. Both forms are cognitive evolutionary adaptive responses to specific context stimulus (Evans, 2008): to illustrate, people do not rely on reflective processing to escape from a lion attack. Thus, we conceptualize the use of intuition and reflection as a result of the organization 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 load or inductive approaches, time constraints and, ego depletion drive individuals to rely more on one processing mode (Rand, 2016; Zhong, 2011). This view is consistent with our experimental design and with previous 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) show 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).

Fourth, 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 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 impacts the firm ability of updated information and adjust their routines to cope with the environment (Lee & Puranam, 2016; Nadkarni & Chen, 2014). This is 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). In conclusion, while management research might be accused to produce theories that explain the past rather than predict the future, our study contributes overall to the field with a theoretical framework causally accountable.

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 using field data can supplement our results by assessing the relative treatment effect sizes for specific contexts (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, Foss, & Ployhart, 2015). 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, Felin, & Whetten, 2010). However, an important challenge in this endeavor exists in 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, Lovallo, & Fox, 2011, p. 1374). 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).

Moreover, 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). 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. In sum, 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.

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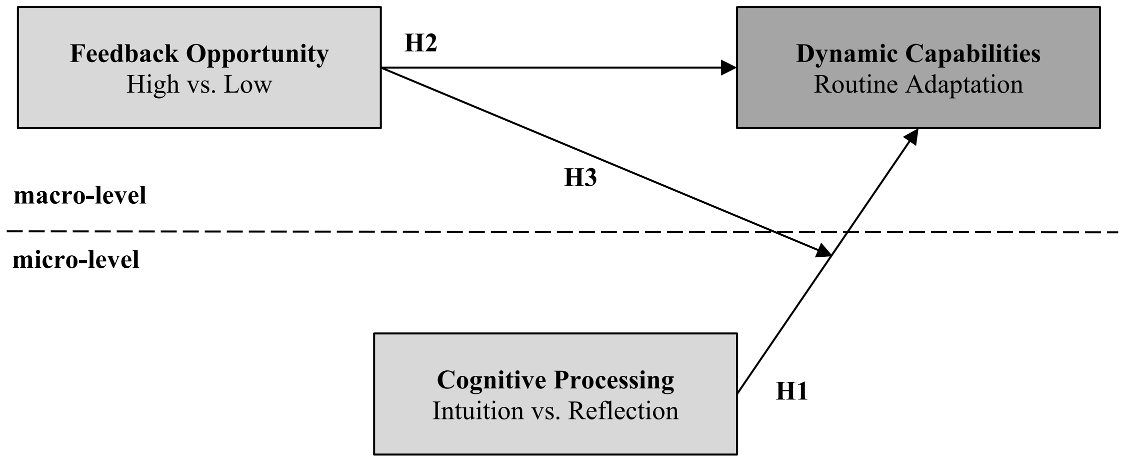

Figure 1. *Theoretical Framework*

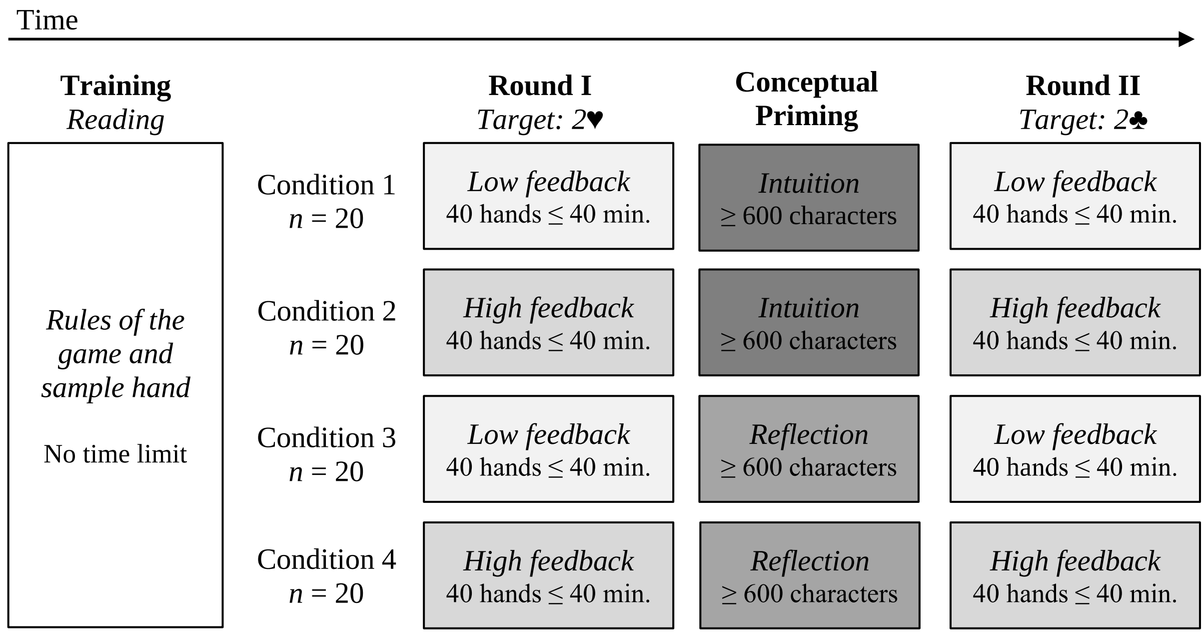

Figure 2. Experimental Design

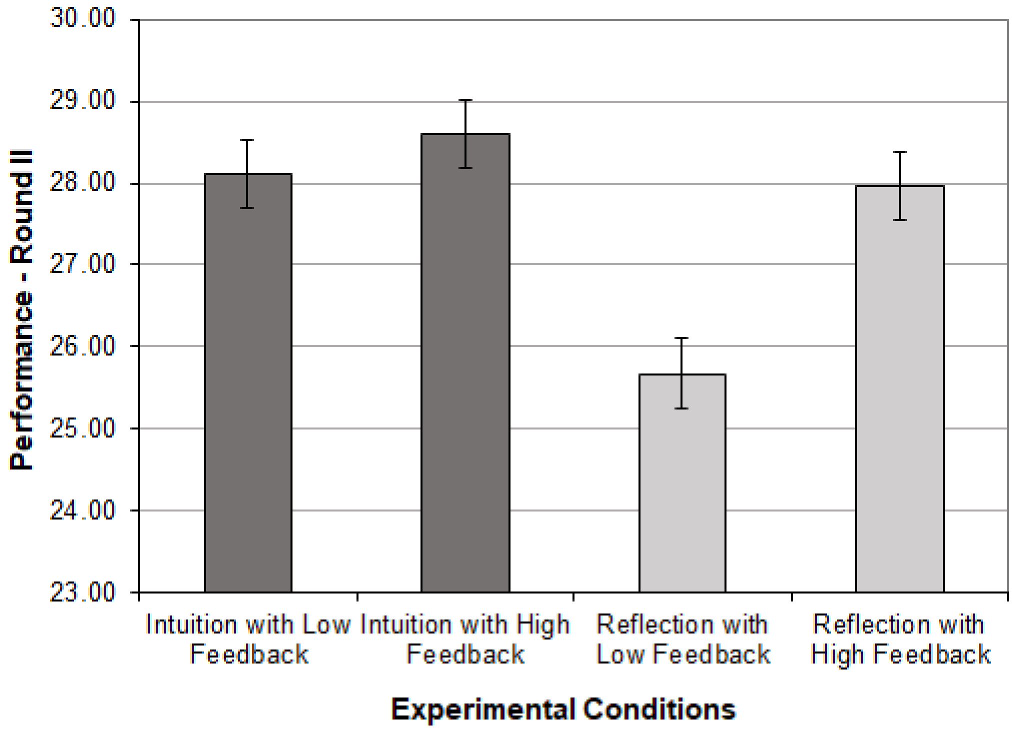

Figure 3. Marginal Effects on Performance After Shock
Note: adjusted predictions with 95% CIs.

Table 1
Variables of the Study

Variable	Cognitive Processing	Feedback Opportunity	Dynamic Capabilities
Type	Independent variable	Independent variable	Dependent 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)

Table 2
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.