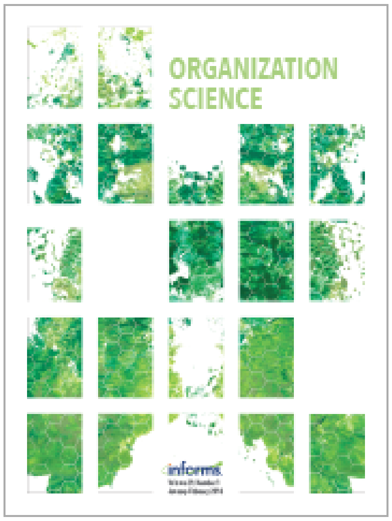

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When Reflection Hurts: The Effect of Cognitive Processing Types on Organizational Adaptation to Discontinuous Change

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Abstract. Technological breakthroughs, institutional disruptions, and natural disasters often alter the course of organizations and entire industries. Such discontinuous changes threaten organizations' survival by affecting the value of the knowledge accumulated in routines and capabilities. Although it is widely acknowledged that managerial cognition is a critical antecedent of organizational responses to discontinuous change, the role of type 1 (intuitive) and type 2 (reflective) processing in the adaptation of shared patterns of behavior, that is, routines, remains understudied. Drawing on dual-process theory, we propose that particular features of type 1 processing render this approach superior to type 2 processing, especially in highly ambiguous environments in which information is limited and difficult to verify. We tested our hypotheses in a longitudinal experiment linking individual-level factors with organizational-level practices of routine adaptation. Experienced managers, paired in 80 groups, developed routines in a first round of a simulation game; in a second round, we then introduced a discontinuous change making previous routines obsolete in order to observe how they adapted. The data show that priming type 1 processing facilitates organizational adaptation more than type 2 processing by providing faster, more routinized, efficiently coordinated, and optimal responses. In addition, type 1 appears to be more functional in highly ambiguous environments, whereas type 1 and type 2 processes yield similar levels of performance under low levels of ambiguity. Overall, our study advances the understanding of the nondeliberative dimension of organizational adaptation to discontinuous change.

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1. Introduction

The escalating frequency of discontinuous changes, such as disruptive innovation, environmental catastrophes, and institutional shifts, poses significant challenges to organizations (Wiggins and Ruefli 2005, Schreyögg and Sydow 2010). In contrast to more continuous and predictable changes, this type of change constitutes a serious threat to organizations' survival as it suddenly renders obsolete the knowledge accumulated in routines and capabilities (Abernathy and Utterback 1978, Dosi 1982, Tushman and Anderson 1986). In such a context, existing routines can no longer support organizational responses (Meyer et al. 1990), and managerial cognition plays a critical role in adaptation (Tripsas and Gavetti 2000; Eggers and Kaplan 2009; Hodgkinson and Healey 2011, 2014). Indeed, managers are cognitively challenged by the disruption of established knowledge, and they need to act before uncertainty is resolved (Benner 2010). In particular, a well-established stream of research indicates that, following major environmental shocks, reliance on more intuitive, automatic cognitive processing can be a source of inertia favoring adherence to previous assumptions, whereas more reflective and conscious processing that involves questioning old beliefs can better support individual-level adaptation, such as in strategic issue diagnoses (Dutton 1993), competitor categorization (Reger and Palmer 1996), and framing decisions (Hodgkinson et al. 1999).

However, despite the valuable contribution of this body of work to understanding the role of cognitive processing in supporting (or hampering) adaptation in individual tasks, research thus far has stopped short of exploring the effects of type 1 and type 2 processing on organizational-level adaptation,[1] that is, the modification of organizational forms to fit the new environment (Levinthal 1997). Indeed, when facing a discontinuous change, managers are asked to do more than individually shift their prior assumptions. Specifically, they have to learn about the radically changed environment and create novel patterns of collective behavior in which they adapt or drop the existing set of organizational routines (Eisenhardt and Martin 2000). From a cognitive standpoint, this represents a different challenge from adapting individual, one-shot decisions because of the collective and repeated nature of interrelated and path-dependent tasks in organizational routines (Nelson and Winter 1982). Moreover, routines constitute a central mechanism of knowledge accumulation and inertia at collective levels (Nelson and Winter 1982, Polidoro 2020). Accordingly, they represent an essential yet under-investigated element of understanding how organizations adapt (Gavetti 2005, Felin et al. 2012, Winter 2013).

We address this gap by drawing on dual-process theory, which describes human cognition as the interplay between type 1, intuitive, fast, unconscious, associative, heuristic, processing and type 2, analytic, deliberative, time-consuming, effortful, processing (Epstein et al. 1996, Sloman 1996, Evans and Stanovich 2013, Pennycook et al. 2015). We develop and test a theoretical framework suggesting that type 1 processing is superior to type 2 processing in the face of discontinuous change. Our underlying argument is that the nature of change imposes specific cognitive challenges for organizational adaptation for which greater reliance on type 1 processing is more effective than relying more heavily on type 2 processing. Furthermore, we propose that the degree of environmental dynamism constitutes a distinctive property of the environment that moderates the efficacy of the processing types. Specifically, we argue that the benefit of type 1 over type 2 processing is stronger in highly ambiguous environments, in which reliable information is both limited and difficult to verify (Weick 1995, Davis et al. 2009).

To test our hypotheses, we employed the target-the-two game, a game that simulates routine development and adaptation (Cohen and Bacdayan 1994) in a laboratory experiment. The experimental design's main advantage is to provide a longitudinal account of collective adaptation, enabling the investigation of its microfoundations by linking individual-level factors with organizational-level coordination (Winter 2013). Participants, divided into groups of two players, developed routines during the first part of the game, after which they were asked to play a second round following new rules without prior notice. In this way, we introduced a discontinuous change that made previous routines obsolete. Immediately before the discontinuous change, the participants were primed for either type 1 or 2 cognitive processing to observe how the cognitive types influenced organizational adaptation. In addition, we manipulated the ambiguity in the environment across both cycles to emulate the phenomenon of organizational adaptation in environments with different degrees of dynamism.

Our study offers three key contributions to the literature. First, we contribute to advancing the understanding of organizational adaptation by challenging the predominant assumption regarding the efficacy of intentionality and deliberation through a clear demonstration of the value of less conscious, intuitive thinking (type 1 processing) relative to more effortful forms of cognition (type 2 processing). Second, we contribute to the literature on cognitive processing—to date, mainly concerned with individual-level outcomes—by unearthing the mechanisms associated with types 1 and 2 and the collective capacity to adapt along the behavioral dimensions of speed, routinization, optimality, and coordination efficiency. Finally, we enrich the conversation in strategic management on the interaction between managerial cognition and the environment by showing that cognitive processing differences play a more significant role in organizational adaptation in highly ambiguous environments. The discussion section elaborates on how these insights reveal new opportunities for future research on cognition and organizational adaptation.

2. Theory

2.1. Dual-Process Theory

Over the past five decades, the diffusion of dual-process theories has significantly expanded understanding of human reasoning (Wason and Evans 1974), decision making (Kahneman and Frederick 2002), social cognition (Lieberman 2007), higher cognitive processes (Cosmides and Tooby 1996), evolutionary game theory (Bear and Rand 2016), and learning (Dienes and Perner 1999). The two types of information processing encapsulated in dual-process theories have been juxtaposed in a variety of ways: gist versus verbatim (Brainerd and Reyna 2002), automatic versus conscious/controlled (Shiffrin and Schneider 1977), associative versus rule-based (Sloman 1996), reflexive/impulsive versus reflective (Lieberman et al. 2004), implicit versus explicit (Reber 1989), emotional versus controlled (Kuo et al. 2009), and experiential versus rational (Epstein et al. 1996) with the different labels often referring to a more general distinction between intuition and reflection in information processing (Rand et al. 2012, Evans and Stanovich 2013). Aware of the abundance of terminologies stemming from the wide-ranging literature pertaining to dual-process theory, we respond to the call of Evans and Stanovich (2013) and refer to the two processes as types 1 and 2 for the sake of clarity and consistency with the growing literature in management and psychology.

According to the default-interventionist perspective on dual-process theory, the two processes operate sequentially with type 1 processes producing the default responses that may (or may not) be modified or overridden by type 2 processes (Kahneman and Frederick 2002). This perspective developed primarily in the study of basic thinking and reasoning tasks and contributes in several ways to the understanding of heuristics, cognitive biases, and decision-making models (see Kahneman and Klein 2009 for a critical view of these streams of research). Beyond the domain of cognitive science, this perspective informs existing research on how managers make decisions and allocate resources within organizations (see Soenen et al. 2017 for a recent application in organizational theory).

An alternative view of dual-process theory, referred to as the parallel-competitive perspective, suggests that the two types of processing are initiated in parallel and compete with each other for attention and cognitive control (Epstein et al. 1996, Sloman 1996). This formulation derives from the field of social psychology, and it has been recently supported by a growing body of research in social cognitive neuroscience, indicating different neural regions associated with type 1 (e.g., amygdala, ventromedial prefrontal cortex, and basal ganglia) and type 2 processing (e.g., prefrontal cortex and temporal lobe) (Lieberman et al. 2004, Satpute and Lieberman 2006). As a result, multiple relevant problem features may be processed simultaneously to inform a given decision (Epstein 2010).

In this paper, we advocate the parallel-competitive view of dual-process theory supported by evidence from recent research (Pennycook et al. 2015, Trippas et al. 2016, Bago and De Neys 2017). The interplay of two specialized information-processing types informs a more realistic cognitive architecture of decision makers facing complex organizational problems in which both intuitive and reflective reasoning matter (Hodgkinson and Sadler-Smith 2018). In doing so, we extend this tradition in management studies on decision making, strategic change, and innovation (Hodgkinson and Healey 2011, 2014) to the context of organizational adaptation to discontinuous change.[2]

2.2. Hypothesis Development

Several arguments suggest that greater reliance on type 1 than type 2 processing can better support organizational adaptation, following a discontinuous change. First, the two types of cognitive processes differ significantly in the extent to which they can produce functional responses to high levels of complexity, which typically characterize environments in discontinuous change. Phillips et al. (2016) show evidence that type 2 processing effectively overcomes problems defined by more explicit, articulable, and codifiable knowledge. These characteristics favor the application of logical inference and the development of organizing (cognitive) principles to guide action. In line with this evidence, managers more extensively relying on type 2 processing might incur more considerable difficulties in supporting the adaptation of organizational routines when faced with complex environments with no normative answers. In contrast, type 1 processing is found to drive superior performance in tasks with no readily available organizing principle and high complexity, which can be better approached with unconscious thought (Dijksterhuis and Nordgren 2006).

A second argument relates to the difference in response speed between the two types of cognitive processes (Lieberman et al. 2004). Timely responses are typically critical in competitive environments in order for organizations to protect their competitive position and ultimately safeguard their evolutionary fitness (Teece 2007). Being characterized by strong reliance on working memory and high cognitive load, type 2 processing is considerably slower than type 1 processing (Dijksterhuis and Nordgren 2006, Rand 2016). As a consequence, additional time spent on analytical efforts related to type 2 processing might not only be unfruitful, as our first argument suggests, but also come at the cost of the organization losing its competitive position over time. Managers must, therefore, take steps to respond to new environmental conditions long before the uncertainties at hand are resolved (Benner 2010). Despite a lack of precision, type 1 processing facilitates faster responses that allow the organization to learn what patterns work (or not) in the new environment. Managers can more quickly understand and adapt to the changing context by building upon real-time information (Brown and Eisenhardt 1997). Therefore, speed is an essential feature that makes type 1 processing potentially more useful than type 2 in quickly changing (or high-velocity) environments (Eisenhardt and Martin 2000).

Third, recent literature on behavioral change suggests that reflective activity can accentuate previous response patterns (Galla and Duckworth 2015, Gillan et al. 2015, Carden and Wood 2018). This is primarily because changing behavioral patterns requires both (1) abandoning the old context responses and (2) adopting and retaining new responses (Wood and Rünger 2016). More specifically, type 2 processing can increase the salience of particular task features, preventing, in turn, changes in implicit context-response associations (Galla and Duckworth 2015). Type 2 processing can also facilitate self-serving rationalizations, favoring the return to previous responses (Melnikoff and Bargh 2018), thereby contributing to learning myopia that constrains organizations' abilities to adapt (Levinthal and March 1993). Type 2 processes require high levels of cognitive effort; as such, they are challenging to sustain for extended periods of time (Galla and Duckworth 2015, Wood and Rünger 2016). Hence, the retention of new responses may be more difficult for type 2 than for type 1 processing.

In light of these considerations, we hypothesize that greater reliance on type 1 processing can better sustain organizational adaptation because it fosters managerial actions toward more functional, rapid, and malleable recombination of novel and existing routines in response to sudden and radical changes in the environment.

Hypothesis 1. *All else being constant, greater reliance on type 1 than on type 2 processing increases organizational adaptation following a discontinuous change.*

Equally important to understanding organizational adaptation is examining the magnitude of environmental dynamism. From a cognitive perspective, a critical dimension of environmental dynamism is ambiguity (Davis et al. 2009). Organizations compete in markets that differ in terms of customer preferences, regulatory opacity, and market institutions, and thus, managers also differ in their ability to interpret or distinguish environmental cues (March and Olsen 1979). Ambiguity in this context refers to the degree to which decision makers lack information about the meaning and implications of particular events or situations (Weick 1995). If ambiguity is low, managers are better positioned to exploit opportunities, learn quickly, and increase returns because they understand the market, that is, prices, technology, performance, and regulation (Davis et al. 2009). When ambiguity is high, however, information about the environment is only partially available and difficult to obtain, analyze, and verify; thus, managers are unable to plan and set performance goals accurately (Davis et al. 2009). For these reasons, differences in ambiguity concerning the environment can have significant implications for the effect of cognitive processing on organizational adaptation.

Clearly, the two types of processing tend to render more similar effects when ambiguity is low. Conversely, at first glance, highly ambiguous environments most likely undermine routine adaptation, irrespective of whether organization members rely more on type 1 or 2 processing. However, there are reasons to hypothesize that the varying levels of ambiguity might differentially undermine the effectiveness of the two types of cognitive processes. Specifically, because type 2 processing is effortful in nature, it requires clear and readily available information, ease of operation, and support from high levels of working memory (Lieberman 2007, Evans and Stanovich 2013). In other words, more complete information appears to be essential for type 2 processing to flourish, expressed as deliberate and reflective analysis (Phillips et al. 2016). Therefore, type 2 processing can be significantly constrained in highly ambiguous environments by the lack of learning inputs because information scarcity makes planning and analysis difficult. Accordingly, when ambiguity is high, type 2 processing might lead to more mistakes and inappropriate modification of routines, thereby undermining organizational adaptation processes.

In contrast, type 1 processes can take advantage of both explicit and implicit cues from ambiguous environments (Dane and Pratt 2007). Specifically, they can leverage environmental cues, even if those cues are not accessible to conscious awareness (Huang and Pearce 2015). Indeed, a recent meta-analysis—drawing on the observation of 17,704 participants—suggests that type 1 processes can support decisions requiring a holistic view and identify multiple nonexplicit associations between concepts (Phillips et al. 2016). This type of process, in fact, can be favored by the reliance on a memory system that is different from declarative memory and that, through the neural mechanisms of the amygdala and basal ganglia, enhances the recognition of meaningful patterns in the environment (Lieberman et al. 2004). In this sense, type 1 processes can access knowledge, including newly acquired knowledge, in an increasingly automatized way (Lieberman 2000), often accompanied by sensations of "knowing," such as "tip of the tongue" experiences and "gut feelings" (Huang and Pearce 2015).

Type 1 processing can, thus, leverage smaller sets of information from ambiguous environments to provide informative responses through nonconscious pattern-matching processes (Lieberman 2000). In addition, "real-time information also builds intuition about the marketplace such that managers can more quickly understand the changing situation and adapt to it" (Eisenhardt and Martin 2000, p. 1112). For example, Elsbach and Kramer (2003) show that film producers working under extreme ambiguity rely on pattern matching to select better projects. Similarly, Huang and Pearce (2015) find that gut feelings characterizing type 1 processing during early stage entrepreneurial investment decisions can help predict profitable ventures. Managers can, therefore, use type 1 processes to search, synthesize, and filter limited available information and still recognize efficient patterns of routine adaptation to fit new environmental demands (Dane and Pratt 2007).

Therefore, we hypothesize that, when ambiguity is high, greater reliance on type 1 processing is more valuable in supporting organizational adaptation to discontinuous change.

Hypothesis 2. *All else being constant, greater reliance on type 1 than on type 2 processing increases organizational adaptation to discontinuous change more strongly when ambiguity is high than when ambiguity is low.*

3. Method

We tested our hypotheses in a randomized controlled trial utilizing an artificial organizational setting. As our theoretical framework links cognitive processes to organization-level outcomes, testing these relationships in real-world organizations is exceptionally complicated (e.g., isolating cognitive mechanisms from other variables). For this reason, following the recommendations of Aguinis et al. (2011) and Winter (2013), this research employed a group-level laboratory experiment. Group members' interactive learning created a setting that is analogous to organizations, albeit small and short-lived ones (Cohen and Bacdayan 1994, Chambers and Baker 2020).

3.1. Experimental Task

The experimental task comprised a computerized version of the card game target-the-two, developed by Cohen and Bacdayan (1994). The 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. The participants could not see each other's cards; thus, each participant was aware of only half of the board (the participant's card and the other two cards lying face up). Participants could exchange their card with only one of the four cards lying on the board or pass their turn. A special rule demanded that one participant could only exchange with the target position providing that both cards were of the same color, and the other participant could exchange cards only if both cards shared the same number. This rule did not apply to other cards on the board. The participants alternated in their moves until the 2♥ was placed in the target position. No explicit communications were allowed; the participants had to coordinate their actions implicitly via their moves.

We instructed the participants to play two rounds of the game: they solved 40 hands for up to 40 minutes in each round. We used the same 80 card configurations on the board designed by Cohen and Bacdayan (1994). Accordingly, we induced the development of routinized problem-solving behavior among the participants in the first round. Before the start of the second round, without prior warning, we informed the participants about a change in the upcoming round: they had to place the 2♣ in the target position (rather than the 2♥) and reverse their roles (Cohen and Bacdayan 1994). Thus, in the second round, we challenged participants to cope with an exogenous shock and adjust their existing routines—a longitudinal shift that simulated organizational adaptation (Wollersheim and Heimeriks 2016). Although the other rules and elements of the game remained the same, it is important to highlight that this change was nontrivial. Even if a given configuration of cards appeared in both rounds and the participants remembered the exact moves used previously, they could not solve the hand by repeating those moves.

This task provided the opportunity to investigate the microfoundations of organizational adaptation as it links individual-level factors with the organization-level practice of coordinated behavior (Winter 2013). Our study participants, similar to organizational members, were organized into groups of individuals who needed to coordinate themselves to carry out a specific activity, which required the development of routines first and then adaptation of those routines, following the introduction of a discontinuous change. Specifically, the game offered a laboratory setting with "miniature organizations with behavior patterns that are organizational routines" (Cohen and Bacdayan 1994, p. 559). The participants were required to work in groups of two (i.e., miniature organizations), coordinate their repeated behavior (i.e., develop routines), and learn to adjust their coordinated behavior (i.e., adapt) after the introduction of a discontinuous change (i.e., a change in the game rules and the roles of group participants). Performance depended on groups' capacity to coordinate their behavior effectively (i.e., choosing the right path of coordinated actions) and efficiently using fewer resources (i.e., fewer moves and less time) to complete the task. As in the managerial context, groups needed to adapt to new environmental conditions in a coordinated manner. As further evidence of external validity, the logic and insights of this task are also evidenced in studies with real organizations, showing, for instance, that prior experience can harm future organizational performance when applied to a slightly different setting (Hoang and Rothaermel 2010).

After Cohen and Bacdayan (1994), other studies in organizational theory have adapted the original task to study path dependence by priming groups with specific solutions to the hands (Egidi and Narduzzo 1997), to study incentives by creating alternative remuneration schemes (Garapin and Hollard 1999), and to study dynamic capabilities by introducing a third round with four players instead of two (Wollersheim and Heimeriks 2016). To test our hypotheses, we adapted the experimental task by introducing two manipulations central to our theoretical framework: cognitive processing and ambiguity.

3.2. Sample and Incentives

We recruited 96 graduate students in management for the pilot study and 160 MBA students for the main study reported here. We invited to the main study only full time–employed decision makers with managerial experience leading a group, either as corporate executives or as entrepreneurs.[3] The participants of the two studies were recruited from different universities. Additional information on the sample is available in Section S2 of the online appendix.

Formal sample size calculations were limited by the lack of prior evidence regarding the effect of cognitive processing on adaptative behavior, and pilot studies are not a reliable source to estimate effect sizes (Albers and Lakens 2018). A sensitivity analysis conducted with G*Power (Faul et al. 2009) showed that, assuming two-tailed α = 0.05, our sample provided 80% power to detect medium effects of $\eta^2 \geq 0.05$ for a between-subjects ANOVA testing the interaction between cognitive processing and ambiguity. However, G*Power does not account for interaction patterns, such as reversing or attenuating the main effect, which has serious implications for power analysis (Lakens 2020). Therefore, in Section 4.1, we report the results with a power analysis a posteriori using the R package Superpower (Caldwell et al. 2021). This package uses a Monte Carlo simulation (5,000 iterations, α = 0.05) to detect our study's actual power considering the shape of the interaction. This analysis suggests that our sample size is appropriate.

Similar to Laureiro-Martínez and Brusoni (2018), we offered both a monetary incentive (variable remuneration based on task performance) and a nonmonetary incentive (a detailed report comparing personal performance with the group average) in exchange for executive participation.[4] No incentive related to course credit was provided. The financial remuneration system designed by Cohen and Bacdayan (1994) is a function of one dollar per hand completed less 10 cents per move required to put the 2♥ or the 2♣ in the target position. Consequently, participants had to "play quickly in order to increase the number of hands completed" and "play carefully in order to avoid unnecessary moves in completing each hand" (Cohen and Bacdayan 1994, p. 560). Because basic analyses were necessary to determine the amount paid, participants received their payment in cash (*M* = 25.57, *SD* = 1.03) within seven days. On average, the individual remuneration of the first round (*M* = 11.77, *SD* = 0.57) was lower and exhibited less variability than that in the second round (*M* = 13.79, *SD* = 0.73).

3.3. Procedure[5]

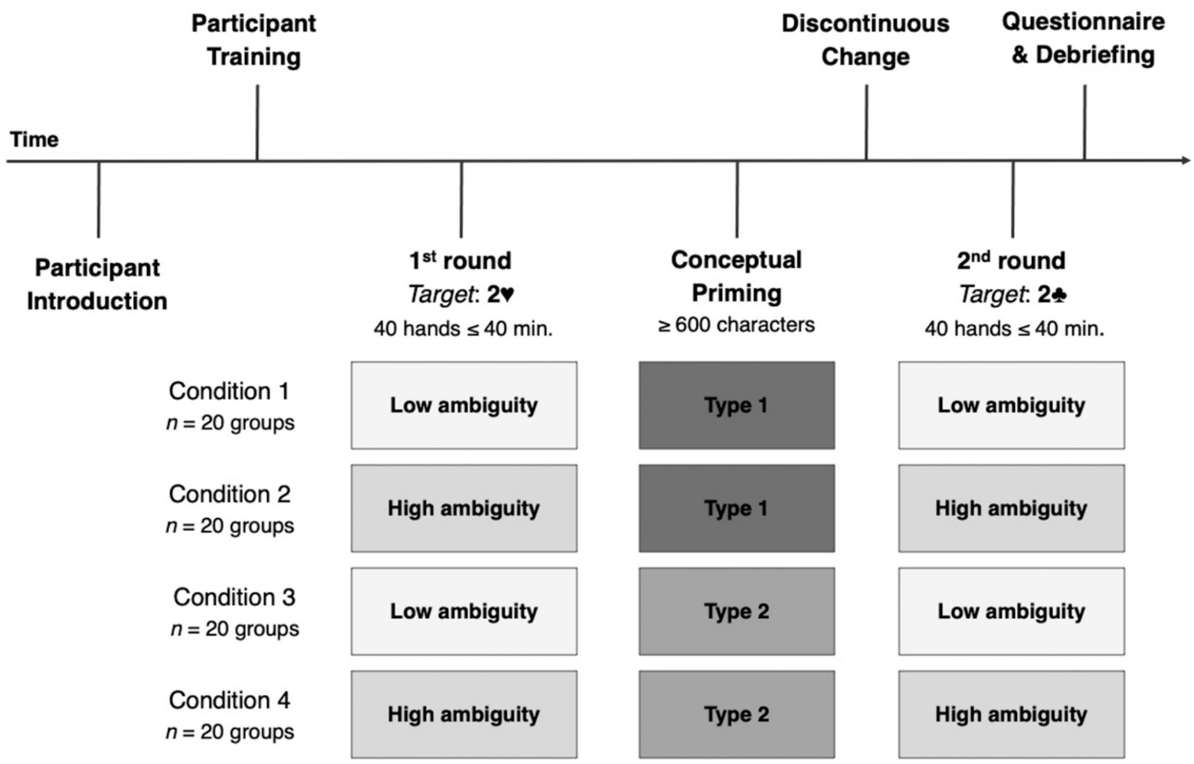
To provide robust evidence while testing our predictions, we followed the best practices in randomized controlled trials. First, participants were randomly assigned—without their knowledge—to one of four experimental conditions in a between-subjects factorial design: 2 (cognitive processing, type 1 versus type 2 processing) × 2 (ambiguity, high versus low). Specifically, we adopted a randomized block design to keep the same number of observations in each condition, that is, 20 groups (Urbaniak and Plous 2013). Second, we employed a triple-blind experimental design to reduce assessment bias. Thus, (1) the participants, (2) the research assistants who administered the task, and (3) the researcher who analyzed the data were not aware of the treatments (Dawes 2010). Figure 1 summarizes the overall design of the experiment (detailed instructions provided to the participants are available in Section S1 of the online appendix).

Upon entering a computer laboratory, the participants had to read and sign an informed consent form prior to the experiment, and none of them declined. As in Cohen and Bacdayan (1994) and Wollersheim and Heimeriks (2016), the participants had access to the rules/instructions and a sample of a solved hand. After the instructor read all of the information aloud, the participants could ask questions publicly. Then, the participants logged into the system, and they were blindly assigned to pairs. They were not allowed to communicate at any time during the experiment or to return to the training screen. They completed the priming treatment in the same PC application between the rounds of the game. Finally, the participants answered one open question regarding their impressions of the experience after filling out a questionnaire (i.e., demographic characteristics, manipulation checks, attentiveness checks, and controls). Although the participants were also given the option to contact us for further information, none of them did. Overall, the experiment lasted approximately 90 minutes. After data collection, we debriefed the participants by emailing them a succinct, nontechnical summary describing the purpose of the study, its method, its findings, and a personal report outlining their own results.

3.3.1. Cognitive Processing Manipulation.

We manipulated cognitive processing using conceptual priming, which is well established in previous research on cognitive processes to induce participants to favor intuition over reflection and vice versa (Rand et al. 2012, Cappelen et al. 2013, Ma et al. 2015). We introduced this manipulation only after the first round to capture

Figure 1. Experimental Design



the effect of cognitive processing types on organizational adaptation, that is, routine adaptation, following a discontinuous change. Accordingly, after completion of the first round, we asked half of the participants to write at least 600 characters recollecting a situation in which their intuition (type 1 processing) led to a positive outcome or their reflection (type 2 processing) led them to a negative one (both promoting intuition or type 1 processing) and half of them to do the opposite (both promoting reflection or type 2 processing). In this way, we counterbalanced valence with both positive and negative outcomes in each of our two conditions.

3.3.2. Ambiguity Manipulation. Ambiguity was manipulated by varying the degree to which decision makers had information about the meaning and implications of particular events or situations (March and Olsen 1979, Weick 1995). In the high-ambiguity condition, the participants had access to the (1) hand number, (2) total elapsed time, and (3) number of moves made in the hand. In the low-ambiguity condition, we introduced a hand index to the participants: as they moved the cards, they were also informed about how far they were from the optimal solution, that is, the minimum number of moves required to solve that hand. Therefore, the groups were supported with dashboards for making decisions with different levels of ambiguity. We increased the completeness of the information available to make causal inferences during the game in one condition; consequently, we varied the degree of environmental ambiguity across the groups (Davis et al. 2009).

3.4. Measures

3.4.1. Dependent Variable. We measured organizational adaptation, our primary dependent variable, by assessing the *performance* of coordinated behavior following a discontinuous change. Similar to Wollersheim and Heimeriks (2016), our dependent variable is given by the money gained by the groups in the second round (i.e., after the novelty manipulation). Unlike in real competitive markets, performance in the game can be attributed only to the participants' ability to adjust their routines to cope with environmental change. The participants had to make better use of the resources (i.e., number of moves and time) and increase the efficiency and effectiveness (i.e., the sophistication of moves) of their actions, captured by performance (i.e., the money gained) (Cohen and Bacdayan 1994, Garapin and Hollard 1999). Accordingly, this experimental measure is superior to existing ones in the literature because (1) it captures the modification of shared patterns of action, (2) money gained is entirely a result of the participants' behavior, (3) the measure captures behavior after the change manipulation, and (4) performance is not subjected to self-evaluation (Wollersheim and Heimeriks 2016). In summary, this experimental measure constitutes a group measure of adaptive success.

3.4.2. Independent Variables. *Cognitive processing* and *ambiguity* were directly measured by the group manipulation. Therefore, each variable was modeled as a dichotomous variable indicating the treatment category in which 1 = type 1 and 0 = type 2 processing. For information availability, 1 = high and 0 = low ambiguity.

4. Results

4.1. Hypothesis Tests

We examined the groups' *performance* in the second round (postdiscontinuous change) to determine the relative effect of *cognitive processing* (type 1 or 2 processing) by *ambiguity* (high, low) on organizational adaptation. All results are reported with two-tailed tests. Data were screened for conformity with ANOVA assumptions (linearity, homogeneity, normality, outliers), and no concerns were found. The homogeneity of variances was confirmed with Levene's test ($F(3,76) = 0.57$, $p = 0.637$). In addition, the manipulation check results (available in Sections S6 and S7 of the online appendix) indicate that both the cognitive processing and ambiguity manipulations were successful.

Table 1 shows the descriptive statistics for performance across the treatments, and Table 2 presents the intercorrelations among the main variables. A 2 × 2 between-subjects ANOVA was employed to test the effect of *cognitive processing* and *ambiguity*. The main effect of *cognitive processing* on *performance* was significant ($F(1,76) = 52.55$, $p < 0.000$, $\eta_p^2 = 0.409$, power = 1.00), showing that the groups assigned to the type 1 processing condition ($M = 28.35$, $SD = 0.93$) were more likely to perform better postdiscontinuity than the groups assigned to the type 2 processing condition ($M = 26.82$, $SD = 1.51$). This supports Hypothesis 1—greater reliance on type 1 processing leads to better organizational adaptation following a discontinuous change than does type 2 processing. Effect size examination suggested that our treatment created a strong differential in adaptation for the groups; cognitive processing accounted for 40.9% of the variance in performance between conditions. In addition, the

Table 1. Descriptive Statistics (Means and Standard Deviations) Pertaining to Group Performance, According to Treatment and Round

Treatment	1st round	2nd round
Type 1	23.59 (1.16)	28.35 (0.93)
Type 2	23.50 (1.14)	26.82 (1.51)
Low ambiguity	24.04 (1.07)	28.28 (0.95)
High ambiguity	23.05 (1.01)	26.89 (1.57)

Note. Standard deviation of the mean in parentheses.

Table 2. Intercorrelations of Study Variables

Variables	(1)	(2)	(3)
Cognitive processing			
Ambiguity	0.000 (1.000)		
Performance – 1st round	0.039 (0.728)	0.432 (0.001)	
Performance – 2nd round	0.526 (0.000)	0.476 (0.000)	0.240 (0.032)

Note. *p*-values in parentheses.

main effect of *ambiguity* on *performance* was significant ($F(1,76) = 43.08$, $p = 0.000$, $\eta_p^2 = 0.362$, power = 1.00): groups in the low-ambiguity condition ($M = 28.28$, $SD = 0.95$) were more likely to perform better postdiscontinuity than groups assigned to the high-ambiguity condition ($M = 26.89$, $SD = 1.57$). Moreover, these main effects were qualified by a significant interaction between cognitive processing and ambiguity ($F(1,76) = 18.12$, $p = 0.001$, $\eta_p^2 = 0.193$, power = 0.99).

Supported by the significant interaction term, we ran a series of planned comparisons to test Hypothesis 2. First, the results indicate that the groups operating under low ambiguity in the type 1 condition ($M = 28.60$, $SD = 0.93$) compared with the type 2 condition ($M = 27.96$, $SD = 0.88$) performed slightly better ($F(1,38) = 4.85$, $p = 0.034$, $\eta_p^2 = 0.113$, power = 0.89). Because of the relatively small difference between groups (i.e., 2.3%) and given that the effect size of the treatment in this condition explained only 11.3% of performance, we conducted a subsequent analysis using a Bayesian *t*-test (Rouder et al. 2009). The Bayes factor indicated that our effect is two times more likely to occur than not ($BF_{10} = 1.999$, error = 0.003%). The Mann–Whitney U test yielded a qualitatively similar result based on 5,000 iterations ($BF_{10} = 1.058$). A Bayes factor between 0.33 and 3 is considered inconclusive or only anecdotal evidence for a difference (Lee and Wagenmakers 2013). Therefore, despite the power of the analysis, that is, 80%, we conclude that there was no evidence in favor of either type 1 or 2 processing in conditions of low ambiguity.

Second, the results indicate that the groups operating under high ambiguity in the type 1 processing condition ($M = 28.11$, $SD = 0.88$) compared with the type 2 processing condition ($M = 25.68$, $SD = 1.07$) performed meaningfully better ($F(1,38) = 61.42$, $p = 0.000$, $\eta_p^2 = 0.618$, power =1.00). The cognitive processing treatment accounted for 61.8% of the performance variability between the groups, showing that the effect size increased under high-ambiguity conditions. This result supports Hypothesis 2—when groups relied more on type 1 than 2 processing, they exhibited higher performance postdiscontinuity under high ambiguity ($\Delta_{performance} = 2.43$) than under low ambiguity ($\Delta_{performance} = 0.63$).

Figure 2 summarizes the results presenting the marginal effects of the 2 × 2 between-subjects ANOVA, that is, the expected performance for each treatment after the exogenous shock. Although the percentage difference between type 1 and 2 processing groups was not large, that is, 5.70% on average and 9.46% in conditions of high ambiguity, our priming treatment constituted a light intervention between rounds, which clearly did not change the actual endowment of competence of the two sets of players or their incentives. Therefore, our data support both of our hypotheses on the relative effectiveness of type 1 over 2 processing in enhancing organizational adaptation to discontinuous change.

In addition, to understand both the initial and long-term effects of *cognitive processing* types on *performance* after the discontinuity, we conducted an interrupted time-series analysis (Figure 3). Following Chambers and Baker (2020), we used ordinary least squares regression with Newey–West standard errors to account for autocorrelation and heteroskedasticity (Linden 2015). Table 3 shows that groups in the type 1 and 2 processing conditions did not differ in their intercepts ($\beta = 0.006$, $p = 0.939$) or slopes ($\beta = -0.000$, $p = 0.977$) prior to the discontinuity. We also observed no significant difference between the treatment groups in the performance level immediately following the introduction of the discontinuous change ($\beta = -0.063$, $p = 0.316$). Therefore, the groups in both the type 1 and 2 processing conditions experienced the same initial decrease in performance following the discontinuous change. However, the postdiscontinuity difference in trends suggests that performance trajectories after the discontinuity differed between type 1 and 2 processing ($\beta = 0.007$, $p = 0.038$). Specifically, for every additional hand, the model predicted 2.79 times higher performance for type 1 ($\beta = 0.010$, $p = 0.000$) than type 2 processing ($\beta = 0.004$, $p = 0.000$). This result lends additional support to Hypothesis 1 and is particularly interesting for two reasons. First, we observe that the groups in both conditions could adapt to discontinuous change; the difference is in their level of adaptation. Second, although we primed the participants immediately before the second round, this treatment altered their performance trajectories in the long term.

Figure 2. (Color online) Marginal Effects of Group Performance Postdiscontinuity

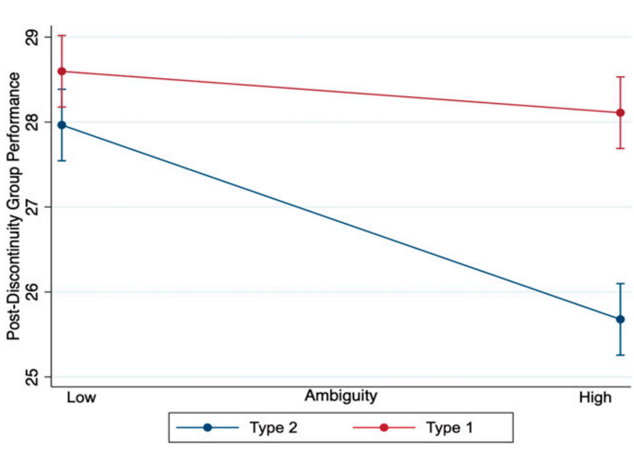
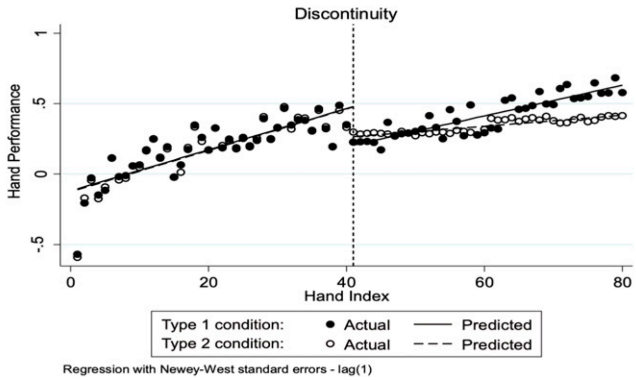


Figure 3. Interrupted Time-Series Analysis Comparing Type 1 and Type 2 Conditions Before and After Discontinuity



4.2. Behavioral Analyses

In this section, we investigate the mechanisms by which type 1 processing facilitated the development of organizational capacity to adapt to discontinuous change. Specifically, groups were compared along the dimensions of (1) deviation from optimality, (2) speed, (3) routinization, and (4) efficiency of coordination (Cohen and Bacdayan 1994, Wollersheim and Heimeriks 2016).

First, Cohen and Bacdayan (1994) suggest that routinized behavior might lead to an overreliance on previous patterns to the detriment of solutions closer to

Table 3. Interrupted Time-Series Analysis of Postdiscontinuity Effects on Performance

Variable	Coefficient	p-value
Prediscontinuity difference in intercepts	0.006 (0.084)	0.939
Prediscontinuity difference in trends	−0.000 (0.003)	0.977
Postdiscontinuity difference in intercepts	−0.063 (0.062)	0.316
Postdiscontinuity difference in trends	0.007 (0.003)	0.038
Type 1 condition trend	0.010 (0.001)	0.000
Type 2 condition trend	0.004 (0.000)	0.000

Notes. Standard errors in parentheses. Nonsignificance in the prediscontinuity difference in intercepts and trends (i.e., slopes) indicates that the type 1 and 2 groups are appropriate counterfactuals (Linden 2015).

"optimal." Therefore, suboptimal patterns increase the number of moves beyond those required and, therefore, reduce the efficient use of resources (Garapin and Hollard 1999). In accordance with Cohen and Bacdayan (1994), we observed overreliance on the UU*T sequence. Specifically, the groups in the type 1 processing condition (M = 12.55, SD = 1.52) used the UU*T sequence less often than the groups in the type 2 processing condition (M = 13.40, SD = 2.17; $F(1,79)$ = 4.12, p = 0.046, η_p^2 = 0.050). However, this original measure does not directly capture how actions differ from the optimal solution. Consequently, we complemented this analysis on (sub)optimality by measuring the deviance from the optimal solution as the number of unnecessary moves used in each hand. We found that the groups in the type 1 processing condition deviated by 1.92 moves (SD = 1.31) from the optimal set of moves, and the type 2 processing groups deviated by 2.69 moves (SD = 1.43; ($F(1,3198)$ = 248.65, p = 0.000, η_p^2 = 0.328). Interestingly, we also observed that, on average, the deviation from optimality in the first round was 4.33 moves (SD = 2.26) per hand, suggesting that the groups generally fell into the suboptimal traps less after the discontinuous change.

Second, to examine whether groups differed in increased speed, we ran regressions with hand number as the independent variable and average move time per hand as the dependent variable (Cohen and Bacdayan 1994). Overall, the move time was stable during the first round (b = 0.001, t = 1.27, p = 0.205, r^2 = 0.000), whereas after the discontinuity, we observed that each additional hand increased the time per move by 0.06 second in the type 1 processing condition (t = 17.39, p = 0.000, r^2 = 0.159), and the time per move decreased slightly by only 0.006 second in the type 2 processing condition (t = −2.42, p = 0.015, r^2 = 0.003). To control for difficulty, Cohen and Bacdayan (1994) repeated the first five hands later in the game and compared the groups' behavior. Replicating this analysis, we found that the participants in the type 1 processing condition used 3.91 versus 5.05 seconds per move, and those in the type 2 processing condition used 5.34 versus 5.20 seconds. This result indicates that, although the type 1 processing groups reduced their speed of action over time and the type 2 processing groups experienced a minor increase in velocity, the type 1 processing groups were still faster on average (β = −3.826, p = 0.001). Specifically, the type 1 processing groups completed the second round in 18.09 minutes (SD = 3.79), and those in the type 2 condition completed the second round in 22.85 minutes (SD = 3.50). In contrast, the groups in the first round completed the game in 24.65 minutes (SD = 3.55).

Third, we examined whether the groups in the type 1 condition differed from those in the type 2 condition in their tendency to routinize—that is, we examined the degree to which the groups relied on specific patterns of behavior. After routinization in the first round, adapting patterns is particularly difficult. We observed that, on average, the type 1 processing groups repeated each pattern three times to complete a hand during the second round (SD = 0.12), and the type 2 processing groups repeated each pattern 2.54 times (SD = 0.15) ($F(1,79)$ = 239.85, p = 0.000, η_p^2 = 0.755). Moreover, we observed that, during the first round, the groups relied on 2.89 patterns (SD = 0.26) on average. This result suggests that, although the type 1 processing groups were able to increase routinization compared with that in the prediscontinuity phase, the type 2 processing groups kept searching and implementing more alternative patterns instead of relying on a smaller set of routinized behaviors.

Fourth, the efficiency of coordination measures the "increased ability of the [groups] to produce an acceptable result" (Cohen and Bacdayan 1994, p. 558) when communication is constrained as in the case of the physical separation of departments (Garapin and Hollard 1999). We computed this measure by regressing the number of moves on the hand number. We observed that, after the discontinuity, the type 1 processing groups decreased the number of moves per hand by 0.11 (t = −53.94, p = 0.000, r^2 = 0.645), and those in the type 2 processing condition reduced the number of moves by 0.04 (t = −14.66, p = 0.000, r^2 = 0.118). We also compared the coordination efficiency among the first five hands and their later repetition in the game. We found that, on average, the type 1 processing groups used 7.82 moves (SD = 0.85) in the first five hands and then 4.95 moves (SD = 0.77) the second time when the five hands were repeated. In contrast, the type 2 processing groups needed 7.11 moves (SD = 1.24) the first time and 6.08 moves (SD = 1.09) the second time. Overall, these findings suggested a superior value of type 1 over type 2 processing for coordination efficiency. However, considering that, before the introduction of the discontinuous change, the groups reduced the number of moves per hand by 0.15 (t = −60.95, p = 0.000, r^2 = 0.537), it appears that groups in neither the type 1 nor the type 2 condition were able to reach the level of coordination efficiency that existed prior to the discontinuity.

4.3. Robustness Check

To qualify our findings, we ran a set of supplementary analyses. These analyses are summarized here for the sake of brevity with Section S11 of the online appendix providing more details. First, we ensured that our analyses were not affected by sample bias, such as survivorship bias, by comparing the demographic profiles of the nonrespondents and the respondents (Di Stefano et al. 2015). Second, we evaluated the experimental process. We observed no difference between the groups assigned to the cognitive processing conditions in their performance in the first round before the cognitive processing manipulation. Furthermore, we included an attentiveness check to test for diligent behavior in following the instructions (Oppenheimer et al. 2009), and none of the participants failed this check.

Third, we checked the duration of the cognitive processing manipulation by further analyzing the speed of the groups in the type 1 and 2 processing conditions to ensure that the treatment effect persisted until the experiment ended. Subsequently, we also ruled out the possibility that the effect of promoting intuition (type 1 processing) versus reflection (type 2 processing) differed based on positive or negative outcome valence (Rand et al. 2012). In addition, the time reading the instructions and paragraph length did not affect the results, in line with previous studies with a similar design (Rand et al. 2012). To further ensure the robustness of the experimental process, a psychologist (B.S., M.Sc.) examined the textual content of the conceptual prime to guarantee the appropriateness of the manipulation.

Additionally, we verified that individual-level differences among the treatment groups, that is, gender, age, risk preferences, overconfidence, experience with virtual games or playing, and other job-related characteristics, did not affect the manipulations. Finally, we also analyzed the data collected from a pilot study, and the results were qualitatively consistent with the ones presented here. Specifically, we found that the effects of greater reliance on type 1 relative to type 2 processing were slightly stronger in the graduate student sample than in the manager sample presented here. Considering this set of robustness checks, we conclude that our results are robust.[6]

5. Discussion

A key source of variation in organizational adaptation is managerial cognition as it engenders both routine inertia and change. To the best of our knowledge, our study is the first to systematically investigate the role of cognitive processing types in supporting the adaptation of coordinated patterns of behavior. The data show that priming for type 1 processing is associated with a higher capacity to adapt to discontinuous change than priming for type 2 processing. Furthermore, our results demonstrate that this effect is stronger in environments characterized by high ambiguity. These findings have important implications for studying organizational adaptation to discontinuous change, for efforts to explore its cognitive microfoundations, and for understanding the interaction between managerial cognition and the environmental context.

5.1. Theoretical Contributions

5.1.1. Dual-Processing Theory and Organizational Adaptation. Our study contributes to understanding organizational adaptation, showing that greater reliance on type 1 than on type 2 processing is more effective in dealing with discontinuous change. Whereas prior work on individual-level outcomes in conditions of change has emphasized the inherent qualities of type 2 processing (Hodgkinson 1997, Hodgkinson et al. 1999), our results, informed by recent developments in dual-process theory (Pennycook et al. 2015, Trippas et al. 2016, Bago and De Neys 2017), suggest that a dynamic mix of type 1 and type 2 with a higher proportion of intuitive thinking can better support collective adaptation in the case of discontinuous change.

This conclusion supports the burgeoning empirical evidence in different settings (Bingham and Eisenhardt 2011, Laureiro-Martinez 2014, Huang and Pearce 2015) questioning previous assumptions of intentionality and deliberation that dominate organizational adaptation research. The modification of organizational routines has been extensively studied as the result of planning and intentional recombination (Simon 1947, Cyert and March 1963), effortful initiatives (Helfat et al. 2007), and deliberate learning (Zollo and Winter 2002) although limited attention has been given to alternative mechanisms of adaptation (Brown and Eisenhardt 1997, Miner et al. 2001). An extensive review by Sarta et al. (2021) captures this predominant view in the literature well, indicating that intentionality "rooted in the organizational members' awareness in the environment" (p. 46) is a defining feature of organizational adaptation. In contrast, our findings document that, under certain conditions (i.e., the need to fit sudden and radical changes in the environment), organizational adaptation is primarily a result of less conscious processes (i.e., type 1 processing). We, thus, suggest that an overarching understanding of organizational adaptation should consider the interplay of type 1 and 2 processing, in line with March's (1981, p. 572) notion that organizations should "maintain a balance (or dialectic) between explicitly sensible processes of change … and certain elements of foolishness that are difficult to justify locally but are important to the broader system."

Ultimately, our study offers new evidence unearthing the longer term, cumulative, adaptive effects stemming from cognitive processing. Our interrupted time-series analysis shows that groups primed with type 1 processing made consistently better use of (scarce) resources over 40 hands, potentially implying a capability-building effect. In particular, when controlling for learning-by-doing effects (the same number of repeated sequences and ambiguity conditions), we found that the participants primed for type 1 processing made consistently better use of experience, possibly supported by higher levels of emotional activation and unconscious processing of environmental cues (Brusoni et al. 2020). Considering that our study examines the effect of priming type 1 and 2 processing only immediately prior to a discontinuous change, future research might investigate learning processes related to type 1 and 2 processing for capability building in order to advance our understanding of how organizations can build capabilities for adaptation to discontinuous change or even build dynamic capabilities (Zollo and Winter 2002, Teece 2007, Hodgkinson and Healey 2011, Helfat and Peteraf 2015).

5.1.2. Behavioral Mechanisms of Organizational Adaptation. Another significant contribution of our work is that it sheds light on the behavioral mechanisms associated with cognitive processing and the *collective* capacity to adapt. Although Felin et al. (2012, p. 1353) assert that the microfoundations of organizations insist on "interactions of individuals, processes, and structures that contribute to the aggregation and emergence of the collective constructs," previous research on cognitive processing largely departs from the observation of individual outcomes (e.g., Reger and Palmer 1996, Hodgkinson 1997, Hodgkinson et al. 1999), leaving out the collective dimension.

This study provides a more granular analysis by observing group-level adaptation resulting from greater reliance on type 1 versus 2 cognitive processing. First, we find that the groups in the type 1 processing condition could better identify the optimal set of moves to complete the task, that is, functional responses, thus avoiding actions (and repetitions) that would lead to detrimental solutions (Cohen and Bacdayan 1994). In contrast to Wollersheim and Heimeriks (2016), who attribute better moves to "greater deliberation in action" (p. 244), our findings align with previous research suggesting that type 1 processing assists in identifying implicit patterns behind noise (Dane and Pratt 2007). Second, in line with prior research, we find that type 1 processing enhances timely responses to environmental changes, potentially assisting organizations in changing before their competitive position deteriorates (Brown and Eisenhardt 1997, Eisenhardt and Martin 2000). Third, we find that the type 1 processing groups relied on a smaller set of patterns, thus exhibiting higher routinization levels. As predicted, those groups exhibited more plasticity than the others as they were better able to recover routinization levels after the disruption that changed the game rules (Galla and Duckworth 2015, Wood and Rünger 2016). Fourth, we find an unexpected effect associated with type 1 processing: we observe that type 1 processing enhanced the efficiency of coordination within groups. This finding suggests that type 1 processing allows groups to orchestrate better actions following an exogenous shock—an essential managerial function and an element of dynamic capabilities (Augier and Teece 2009, Wollersheim and Heimeriks 2016). Indeed, some prior research emphasizes that type 1 processing is superior to type 2 processing in activities that require coordination, such as a "meeting of the minds" (Kuo et al. 2009, p. 519), and it can improve cooperative behavior (Rand et al. 2012). This result is particularly interesting because it highlights a teamwork dimension of type 1 processing that is otherwise obscured in the examination of individual decision-making.

In sum, our data suggest that greater reliance on type 1 processing can enable efficient search and selection of adequate behavioral patterns as well as faster convergence to routinized, collaborative solutions. Our set of behavioral findings encourages future microfoundational research to investigate other collective and interactive phenomena related to organizational adaptation. For instance, future research could examine the effect of cognitive types on change processes, such as coordination in routine dynamics (Kremser and Blagoev 2021), top management coalitions (Augier and Teece 2009), and knowledge exchange between organizations (Di Stefano et al. 2015).

5.1.3. Managerial Cognition and Environmental Context. An additional contribution of our research is to expand the understanding of the interaction between managerial cognition and the environment in strategic management (Brown and Eisenhardt 1997, Nadkarni and Barr 2008, Marcel et al. 2011). Building on the idea that speed is the primary representation of environmental dynamism, prior literature has mainly focused on contrasts between low- and high-velocity environments. Our study adds to this conversation by focusing on ambiguity—another relevant dimension of environmental dynamism (Davis et al. 2009).

Our findings show that the positive effect of type 1 (versus type 2) processing intensifies when ambiguity is high. Therefore, managerial cognition appears to be a key source of variation in organizational adaptation in such environments. This evidence aligns with Nelson and Winter (1982) in that more dynamic environments create more challenges for managers, who, as a result, also have more opportunities for learning. Because of the nature of discontinuous change, there is a limited basis for building capabilities through analytical strategies; instead, managers can leverage implicit cues and learn from intuitive judgments. In this sense, our results provide initial empirical support for the proposition that heuristics are more relevant for strategic change in highly dynamic environments (Davis et al. 2009, Bingham and Eisenhardt 2011).[7] Heuristics have been explored primarily within highly dynamic industries, and our study offers one of the first pieces of comparative evidence on the influence of different degrees of environmental dynamism on the efficacy of cognitive processing types.

Our findings suggest parity between the cognitive types in supporting adaptation when the environment is less ambiguous. In line with the argument from Davis et al. (2009), we find that managerial cognition plays a less significant role in such conditions. Markets in which information about prices, technology, performance, and regulation is fully available can provide a clear course of action to managers (March and Olsen 1979). In other words, with less ambiguity in the environment, there is also less space for cognitive types to favor different responses. This is also shown by the difference in the standard deviation of performance between the low- and high-ambiguity groups, that is, 0.95 and 1.57, respectively.

Overall, our results highlight the relevance of managerial cognition to the ongoing discussion on matching organizations' responses to environmental conditions (Stieglitz et al. 2016). Our microlevel examination of organizational adaptation resembles the general discussion on the disputed value of dynamic capabilities in environments with different degrees of dynamism (Eisenhardt and Martin 2000) with recent research pointing to their higher value in moderately dynamic rather than stable or highly dynamic environments (Schilke 2014). Building on our study's initial insights, future research could overcome the limitations of our dichotomous ambiguity design and investigate to what degree the value of cognitive capabilities for organizational adaptational is contingent on a nonlinear moderation of environmental dynamism. Such research would advance our understanding of the microlevel/macrolevel similarities in organizational adaptation (Felin et al. 2012).

5.2. Managerial Implications

Our study provides two potential insights for practicing managers. The first relates to the design of knowledge-management systems and formal procedures of analysis. Our findings suggest that excessive reliance on such structures can jeopardize managerial action by leaving limited space for type 1 processing. As Mintzberg (1994, p. 111) notes, overreliance on knowledge-management tools might not provide "improved means to deal with the information overload of human brains; indeed, they often made matters worse." Cognitive load, inductive approaches, time constraints, and ego depletion can drive individuals to rely more on single cognitive processing (Rand 2016). As different hierarchical structures shape information processing and decision making (Lawrence and Lorsch 1967), organizational designs might need to emphasize type 1 or 2 processing depending on the *nature* of environmental dynamism, not only its magnitude. Our results then also speak to recent research on the architecture of choice (Thaler et al. 2012, Peysakhovich and Rand 2016, Chambers and Baker 2020), suggesting that organizing the context might be an appropriate way of nurturing the desired cognitive dispositions and behaviors in contrast to the traditional wisdom of addressing decision biases by changing the mind of the decision maker.

The second insight refers to human resource management. Whereas individuals can present systematic preferences for intuition or reflection (Epstein et al. 1996), organizations might also tend to hire and promote individuals who favor analytical reasoning (Levine et al. 2017). However, our results suggest that "there is money left on the table" and that greater reliance on type 1 processing can actually be more effective than reliance on type 2 processing in specific adaptation contexts. Therefore, organizations might not realize the full potential of their human capital if they do not embrace diversity in respect of cognitive processing capabilities. Type 1 and 2 processes each afford specific advantages, and diverse teams can benefit from gathering disconformity evidence, discussing uncertainties, and confronting cognitive biases to drive organizations' competitive advantage. To be clear, our study does not argue that organizations should always prefer type 1 over type 2 processing to enhance their probability of success in dynamic environments. Instead, managers should consider the fit between the two cognitive processes, the environment, and the associated behavioral demands.

5.3. Limitations

The contributions mentioned are bounded by two main design limitations. First, an important refinement of the present study might compensate for the simplification from actual organizational reality. For instance, future research might allow us to elucidate the cognitive underpinnings of adaptation across different types of tasks and initiatives within the same organizational boundaries. As organizations engage in different initiatives across time (e.g., structural, operational, and cultural change projects; alliances; mergers; and product development efforts), these processes and underlying capabilities mutually affect each other and differ in how they are routinized. Moreover, field experiments are needed to test to what extent type 1 processing favors (more than type 2 processing) organizational adaptation in situ. Future studies could assess the relative treatment effect sizes and account for specific organizational contexts (Rubinstein 2001), which might influence the capacity to produce more (or less) functional, rapid, and flexible responses.

A second limitation of the present study is directly connected with the problem of aggregation. Although we model and test for small group effects, which mitigates the problem of organizational "anthropomorphization," the design adopted is still far from accounting for the hierarchical and intensively political processes involved in organization-level decision making (Cyert and March 1963). To the extent that the processes of aggregation may not follow a linear pattern, a promising path for future research to expand the results from our analyses is to understand how (1) organizational design can change collective outputs by influencing the evolution of cognitive mechanisms and (2) individual cognitive dispositions and capabilities can interact in shaping the evolution of organizational traits and related consequences for adaptive fit.

6. Conclusion

The phenomenon of adaptation to discontinuous change is a subject of long-standing inquiry in organizational theory. Organizations struggle to adapt when their capabilities were built for a world that no longer exists (Abernathy and Utterback 1978, Dosi 1982, Tushman and Anderson 1986, Meyer et al. 1990). In such cases, the survival of organizations is under a severe threat. Our research suggests that managers can be advantaged in adapting organizational routines by relying more on intuitive processes rather than reflective ones, particularly in highly ambiguous environments. Thus, our research points to an untapped source of adaptation of collective behavior during extreme conditions of change.

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Endnotes

[1] See Hodgkinson and Healey (2011, 2014) for examples of theoretical research linking cognitive processing with capabilities and radical innovation.

[2] We thank reviewer 2 for encouraging us to address the distinction between default-interventionist and parallel-competitive dual-process theories in our theorizing.

[3] Seventy-seven participants decided to drop out of the experiment because of unexpected workload. Additional information and robustness tests to rule out sample bias concerns are reported in Section S11 of the online appendix.

[4] We introduced the nonmonetary incentive as an additional incentive to motivate honest participation by managers. This incentive was not present in the original version of the game (Cohen and Bacdayan 1994). However, our results in the pilot study following the original remuneration system are qualitatively the same as those of the main study.

[5] We complied with all relevant ethical regulations, including obtaining informed consent from all participants, providing the right to withdraw from the study at any point, and avoiding any deception or incomplete disclosure.

[6] We provide the complete data sets, code, and instruments to replicate the two studies' analyses in Open Science Framework: https://osf.io/v6cz9/?view_only=42fd0b0407f343c494995f52436209c3.

[7] Please note that these studies embrace different theoretical perspectives from dual-process theory.

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