Responses to Organizational Surprises in Startups: 
The Impact of Improvisation and Memory on Response Outcomes

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February 10, 2008

The authors thank Mary Crossan, Tim Pollock and Dusya Vera for their helpful contributions to this work. Earlier versions of this paper were presented at Harvard University, New York University, Babson Entrepreneurship Conference, Academy of Management Conference, INFORMS/Organization Science Conference, and West Coast Technology Entrepreneurship Symposium. We also thank the National Science Foundation Division of Decision, Risk and Management Science Division (Grant #: 0132827), and interview participants for their generous assistance with this project.
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ABSTRACT

This paper offers a conditional framework of improvisation, in a context of organizational responses to surprise events. We propose that two key factors related to organizational knowledge use will shape whether a specific response to a surprise will have value to the organization. First, we argue that intermediate levels of improvisation during responses create conflicts on knowledge deployment that reduce the chances of an effective response. In contrast, both lower and higher levels of improvisation will have a relatively more positive impact on organizational outcomes. Second, the organization’s direct and indirect memory represents a reservoir of potential activities and interpretive schemes, which in turn enhances the chances that its surprise response will have a valued outcome. Finally, we propose that the value of improvisational response is enhanced by the presence of high levels of organizational memory. We test these ideas using a sample of 141 surprise events identified from 1,725 pages of interview transcripts, over 1,000 pages of informant self-rating reports, and rater assessments of these materials. Our study contributes to theories of improvisation, organizational learning, and emerging theories of organizational surprise.
Several research streams highlight the importance of organizational surprises. One recurring perspective emphasizes the potentially negative effects of surprise events and argues that organizations should attempt to avoid surprises through careful pre-planning and sophisticated early detection systems (Watkins & Bazerman, 2003; Weick, 1998). A second perspective argues that surprises are unavoidable but focuses on potential longer-term benefits that occur when the experience of surprise generates organizational learning by spurring mindful attention to errors in shared mental models and operating assumptions (Louis, 1980; Meyer, Gaba, & Colwell, 2005; Okhuysen & Eisenhardt, 2002; Zellmer-Bruhn, 2003). In this paper, we tackle a third set of issues concerning organizational surprises. Like the learning literature, we too assume that surprises are unavoidable, but we focus on organizations’ immediate responses to surprise events and how the organization’s improvisational pattern and its memory level shape the outcome of such responses.

We define surprise as an event that is recognized as unexpected by a focal organization (Louis, 1980). This definition is consistent with prior work that emphasizes the material aspects of surprises, and is distinct from work that emphasizes cognitive or emotional states (Harrison & March, 1984; Schutzwohl, 1998). We propose that two key factors related to organizational knowledge use will shape whether a specific response to a surprise will have value to the organization. First, we argue that intermediate levels of improvisation during responses create conflicts on knowledge deployment that reduce the chances of an effective response. In contrast, both lower and higher levels of improvisation will have a relatively more positive impact on organizational outcomes. Second, the organization’s direct and indirect memory represents a reservoir of potential activities and interpretive schemes, which in turn enhances the chances that its surprise response will have a valued outcome. Finally, we propose that the value of improvisational response is enhanced by the presence of high levels of organizational memory.
Our work contributes to theories of improvisation and organizational learning. The increased scholarly attention to improvisation so far has revealed its potential complex manifestations and impact on organizations, but also raised cautionary flags about how little systematic evidence about its origins, dynamics or impacts in an organizational setting (Hatch, 1997; Miner, Bassoff, & Moorman, 2001; Levinthal & Rerup, 2006). Our study intends to extend this important line of research by developing testing a conditional theory of improvisation. That is, we tackle the question of when an improvisational generates more value in response to a surprise event, in the presence of varying levels of organizational memory. Our study also advances theory about organizational surprises.

We examine the proposed framework in a sample of one hundred forty one surprises in thirty-one firms drawing on interview data, informant self-reporting data instruments, research team action identification, and variable coding based on 1,725 pages of transcripts. Consistent with our theories of the value of very low and very high levels of improvisation, we find a curvilinear pattern in which intermediate levels of improvisation harms outcomes. The total pattern of findings also supports a conditional model of improvisation in which higher level of organizational memory helps drive value out of improvisation activities in response to surprise events.

**THEORY AND HYPOTHESES**

**Research Setting – Surprise Events Experienced by New Firms**

In this paper, we focus on responses to surprises, defined as events that are recognized as unexpected (Louis, 1980; Baker, Miner, & Eesley, 2003). Prior work has examined the impact of surprise events on individuals, groups, industries, armies and even non-human subjects such as information systems (Cunha, Kamoche, & Clegg, 2005; Cohen & Axelrod, 1984; Schutzwohl, 1998). In this study, we focus on the organizational level and examine how differences in
organizational memory and how it is deployed in response to surprise events influence an organization’s satisfaction with the effectiveness of its own response. In this context, a surprise is an event that is recognized as unexpected by the focal organization.

Prior studies of surprise have highlighted the importance of clearly delineating the chain of events that will be examined (Harrison & March, 1984; Mendonca, 2005; Vanhamme, 2000). For this study, we analyze the sequence of events into four elements: (1) a surprise event, (2) the recognition/realization of the event by the organization, (3) the organization’s response to the surprise event, and (4) the organization’s assessment of the immediate outcome of that response. Our focus is on the crucial sub-processes that determine how an organization’s existing body of knowledge and how the organization deploys that knowledge in response to a surprise event shapes its satisfaction with the near-term outcome of its response.

Unlike other important work on the role of surprise in various social systems, we do not examine precursors to organizational surprise, such as environmental jolts (Meyer 1980; Sine & David, 2003), interruption (Zellmer-Bruhn, 2003), threat (Staw, Sandelands, & Sutton, 1981), and crisis (Kim, 1998; Lin et al., 2006), nor do we study organizational effectiveness in avoiding surprise. Our study takes the existence of a surprise event as given. Despite a common scholarly focus on negative surprises (Kim, 1998; Lin et al., 2006), our definition based on the recognition that an event is recognized as unexpected allows for both positive and negative surprises (Greve, 1998). Table 1 presents some examples of surprises from our study. The surprise event may range from something as negative as a threat to the very existence of the organization, to an unanticipated resource or opportunity (Meyer, 1980; Zellmer-Bruhn, 2003).

We focus on organizations’ evaluation of the effectiveness of their responses to surprise events in part because the immediate response to a surprise can play an important role in
organizational adaptation. For example, research on responses to disasters (Lin et al., 2006) and to surprise attacks (Mendonca, 2005) indicate that if whether an organization can devise an immediate fruitful response to some surprises can determine whether and how well the organization recovers. Similarly, the literatures on improvisation and on entrepreneurship (e.g., Baker et al, 2003; Miner et al, 2001) provide numerous examples of the effective immediate exploitation of positive surprise events.

Contemporary practitioners often encourage organizations to be nimble or flexible in the face of unexpected events and change and valorize the practice of improvisation (e.g., Conner, 1998). Such generic advice, however, leaves open major questions about micro-processes and factors that influence whether the particular response to a given surprise event will prove valuable to the organization even in the short run. In our hypotheses we argue that an existing knowledge, in the form of organizational memory, enhances an organization’s ability to respond effectively to surprise events. We also argue that deploying organizational knowledge by engaging in moderate levels of improvisation is likely to detract from effectiveness in responding to surprises, but that either resisting improvisation or engaging in high levels of improvisation may contribute to responses that are effective in the short term. Finally, we argue that organizational knowledge and how it is deployed will interact such that higher levels of memory and high levels of improvisation will interact to create effective responses.

We test our theories by studying surprises occurring in a sample of knowledge intensive start-up firms. We chose this context for two reasons. First, many observers (e.g., Baker & Nelson, 2005) suggest that start-ups may be more prone to experiencing surprises than other firms, making new and young firms a fertile source of data for our study. Second, the start-up setting allows us to test ideas in a setting where we can clearly specify scope conditions. Prior work on improvisation and memory have shown mixed results and the start-up context allows us
to test our arguments under certain scope conditions that we will argue are likely to influence observed results.

**Improvisation and the Outcome of Responses to Surprise Events**

Following Miner, Bassoff and Moorman (2001), we define improvisation as “the deliberate and substantive fusion of the design and execution of a novel production” (Miner et al., 2001: 314). Early studies of organizational improvisation focused on episodes of successful improvisation and thereby focused attention on the positive consequences of improvised behavior (Hutchins, 1991; Preston, 1991; Weick, 2003). Moorman and Miner (1998) laid out a conditional theoretical model in which the nature of the knowledge deployed shapes the degree to which improvisation leads to positive outcomes. Later empirical work has verified that improvised behaviors can produce both positive and negative results (Baker, et al., 2003; Eisenhardt & Tabrizi, 1995; Moorman & Miner, 1998; Vera & Crossan, 2005). Important questions about whether and when improvisation will produce valued outcomes remain, however, and additional research is required to establish boundary conditions around processes of effective organizational improvisation (Miner et al., 2001).

In many cases, a firm’s best response to a surprise will be to continue following established plans or organizational routines, which are built on organizational knowledge that has survived prior internal selection processes and are in many cases still applicable despite the surprise event (March, 1991; Miner, 1991). When planned and routine behavior persist in the face of surprise events, existing organizational knowledge continues to be deployed in the organization’s “usual way,” with employees playing familiar roles and coordinating their behavior in well-understood and integrated patterns. Such routine behaviors may be enhanced by small improvisational “embellishments” (Berliner, 1994; Miner, et al., 2001; Weick, 1998) intended to deal with surprise events, without challenging the coherence and functioning of
established roles and behavioral patterns (Galbraith, 1973; Miner, 1991; Weick, 1993). For example, Miner et al. (2001) described several cases in which established firms were able to improvise solutions to surprise events in production and marketing. Employees engaged in small and successful improvisational embellishments while continuing to follow elaborate product development rules and routines. For example, one firm responded to the surprise of large variations in the performance of a standard system component by improvising a solution that offered the better-performing systems to favored customers as a signal of their preferred status, and thus turned a potential problem into an opportunity. Following the logic that low levels of improvisation permit some adaptation to surprise events while keeping intact the knowledge deployment benefits of established roles and routines, we expect that low levels of improvisation will generate positive outcomes in response to surprises.

High levels of improvisation may also help organizations respond productively to surprises by heightening awareness that “business as usual” is being violated, and thereby increasing shared attention to real-time information and signaling that roles and coordination need to be adjusted on the fly. Consistent with this argument, Waller (1999) found in an experimental study that the ability to respond to real-time information by reprioritizing and redistributing tasks distinguished airline crews able to perform well in response to surprise events from crews with poor performance outcomes. In a striking illustration, Hutchins (1990) described how the crew of a large ship with a failed navigation system improvised a coordinated set of roles that allowed them to bring the ship safely to harbor. This highly improvisational response to a surprise event elicited participants’ close attention to real time information flows and mindful collective engagement with the response (Weick, et al., 1999), even though most of the crew members had little understanding of the overall improvised division of labor they were helping to enact. Improvisation may disrupt normal patterns of knowledge deployment and
require that employees fulfill unfamiliar roles while dealing with challenges to the coordination of complex behaviors. The benefits of previously vetted plans and routines are set aside in favor of new and untried behaviors. Nonetheless, high levels of improvisation may offset some of these disadvantages by encouraging organizational focus on real-time information flows (Moorman & Miner, 1998) and by throwing the ongoing composition of behavior patterns open to mindful task reassignment and reprioritization. We therefore expect that high levels of improvisation will generate positive outcomes in response to surprises.

While we have described the benefits of both low and high levels of improvisation, we argue that firms which engage in moderate levels of improvisation in response to surprise events may suffer the disadvantages of putting aside proven patterns of knowledge deployment without the advantages of increases in collective attention to real time information and role adjustment. As a recent paper (Baker, 2007: 708-709) argued, the “ensemble models of improvisation that many analyses use as metaphors for organizational improvisation” assume that everyone is improvising, but an alternative model is “one in which some actors involved in a novel production (Miner et al., 2001) are improvising, while others are not.” We expect that when organizations respond to surprise events with moderate levels of improvisation, events may unfold in ad hoc admixtures of improvised and non-improvised actions, resulting in confusion about who is or should be doing what and when they should be doing it while crafting the organization’s response. In this situation, improvised actions create emergent roles and interaction patterns that may be poorly coordinated with the organization’s existing roles and interaction routines (Miner, 1990; Weber, 1978). Even if the improvisation generates useful novelty, the benefits of such innovation may be overshadowed by escalating coordination challenges (Weick, 1993) and participants’ behaviors may become uncoordinated or even work at cross purposes.
Our interviews illustrate role system and knowledge integration conflicts among organizations responding to surprise events with mixtures of improvised and non-improvised behaviors. For example, a software startup responded to sudden client demands with a combination of highly improvisational actions to solve customer needs on the fly and contradictory routine actions aimed at enforcing established procedures to constrain contractual ‘scope creep.’ As one founder commented on the failed project, “You’ve got three peoples’ efforts going into something. Two of them are interfering with the one who can get it (CloSoft, 10:36.”) A more dramatic illustration is Weick’s (1993) analysis of the Mann Gulch forest firefighting disaster. As the firefighters responded to the surprise that a huge inferno was suddenly right upon them, one of the senior members of the group improvised by burning an escape fire that allowed him to survive the blaze. The rest of the crew failed to follow him in the improvisation, the firefighters’ role system disintegrated, and most of the crew died. Combining our arguments for low, high and moderate levels of organizational improvisation, we therefore argue:

Hypothesis 1: Responses to surprise events characterized by either high or low levels of improvisation will generate better outcomes than will responses characterized by moderate levels of improvisation.

Organizational Memory and the Outcome of Responses to Surprise Events

We define organizational memory as the collective knowledge of an organization, residing primarily in shared beliefs, behavioral routines and physical artifacts (Argote, 1999; Moorman & Miner, 1997; 1998). Theories of organizational learning suggest that greater organizational memory will increase the chances that a given surprise response will yield good outcomes. There are two key mechanisms by which organizational memory can be value-creating in response to surprises. First, greater organizational memory permits a focal firm to access a more extensive and diverse repertoire of existing responses (Berliner, 1994; Hargadon
& Sutton, 1997). The repertoire includes standard operating procedures (Cohen et al., 1996; Cyert & March, 1992[1963]), behavioral routines (Feldman & Pentand, 2003; Nelson & Winter, 1982), and previously developed contingency plans (Billings, Milburn, & Schaalman, 1980). This opens the door to recombine or apply existing components of organizational memory to effectively address surprise events (Hargadon & Sutton, 1997).

A high level of organizational memory also allows the focal firm to interpret events – including a surprise event – by fitting them into pre-existing categories of events and actions. This categorization helps a firm to retrieve and make connections with useful information from its own prior actions and outcomes (Douglas, 1986; Hargadon & Fanelli, 2002; Lounsbury & Rao, 2004). By understanding and categorizing the surprise event – often through use of analogy (Hargadon & Sutton, 1997) – in terms of similarities with what it has experienced before, the organization can make more effective selections from the repertoire of existing responses in its memory (Cohen & Levinthal, 1990; Daft & Weick, 1984; Day & Nedungadi, 1994; Jackson & Dutton, 1988; Sinkula, 1994).

Organizational memory thus guides action through making available repertoires of potential responses and also through helping to match actions from these repertoires to the surprise event (Moorman & Miner, 1997). In the context of entrepreneurial firms, prior research has suggested two relevant sources of organizational memory – organizational age (Argote, 1999) and the prior experience of founders (Phillips, 2002).

Organizational age. Literature in organizational learning has adopted organizational age as a proxy for organizational memory (Argote, 1999), showing that organizations benefit from their operating history including both success and failure experience (e.g., Ingram & Baum, 1997; Kim & Miner, 2007). Firms accumulate organizational memory during its operating history, which is expected to improve their ability to respond effectively to surprise events.
Specifically, older organizations have had the opportunity to develop diverse action repertoires, making it more likely that a useful response to the surprise will reside in organizational memory (Levitt & March, 1988; Walsh, 1995). Further, the operating history of older organizations makes available a wider array of interpretive tools to make sense of the surprise (Moorman & Miner, 1997). This implies that organizational age will play a positive role in guiding effective responses to surprise events.

Another stream of research, however, suggests that organizational age should reduce the effectiveness of organizational responses, if age is correlated with rigidity (Burgelman, 1983; Dougherty, 1992; Leonard-Barton, 1992). From this perspective, even if memory offers a large action-repertoire and rich interpretive framework, an organization may not take advantage of this potential and instead maintain a highly consistent pattern of action to the point of maladaptive rigidity. This line of reasoning implies that organizational age could have a negative effect on the outcome of responding to surprise events.

To reconcile these conflicting perspectives on organizational age, we turn to the particular research setting of this study. In a start-up context, most firms have not reached a stage of maturity yet. As a result, organizational age related rigidities are less likely and more controllable (Gersick, 1994; Maurer & Ebers, 2006). Under this circumstance, we expect that among young firms, the benefits of organizational age will dominate any inertial tendencies developed along firms’ operating history. Thus, we argue,

\textit{Hypothesis 2a: Older organizations’ responses to surprise events will generate better outcomes than will the responses of younger organizations.}

**Organizational age and improvisation.** Organizational age, as one important source of organizational memory in start-ups, is expected to moderate the effect of improvisation on outcome of responding to surprise events. One of the most fundamental developments in theories of improvisation holds that the value of improvisation can be contingent on the experience level
of the focal actor (Moorman & Miner, 1998; Vera & Crossan, 2005). Improvisation, after all, is rooted in and reflects an organization’s past learning from operating experience. This insight is consistent with what scholars have long observed in many different fields. In jazz and theater, for example, scholars have long noted that the mastery of a diverse repertoire provide the foundations of skillful collective improvisation (Berliner, 1994). At organizational level, Moorman and Miner (1998) further propose that improvisation should generate value in the presence of a high level of organizational memory. They argue that a rich and diverse organizational memory contributes to the coherency, speed and novelty of improvisational actions.

Several important mechanisms may drive such positive interaction effect between improvisation and organizational age. From a perspective of coordination, research on improvisation suggests that the value of improvisational actions can be enhanced by formal or informal systems of communication and coordination, both of which are developed along an organization’s operating history. In older organizations, formal communication and coordination are built into organizational structures and routines (Levitt & March, 1988; Weick, 1993). In parallel, informal communication and coordination evolves along familiarity among organizational members over time, which can absorb potential disruptions on the existing role systems caused by improvisation. Learning about others’ abilities, resources and habits – “knowing who is good at what in the group” (Ren, Carley, & Argote, 2006) – can improve the joint ability of people in older organizations to improvise effectively. For example, in McGinn & Kross (2002) study of social embeddedness and successful improvisation, bargaining partners who were friends prior to negotiations were much more likely to improvise a satisfactory solution than were strangers.
For organizations, a longer operating history may not only increase the level of fruitful interaction via more efficient communication and coordination, but it may also allow for members to learn to improvise together (Baker et al., 2003). Firms may develop improvisational competencies hand in hand with other basic organizing capabilities (Weick, 1979). As organizational members deal with challenges for which they have no obvious prior routines, they learn how to improvise, who they can improvise with effectively, and how to avoid some of the problems that poorly executed improvisation can create. This practiced and potentially nuanced local understanding of improvisational processes helps build the organizational capacity to improvise effectively. Consistent with this argument, Moorman & Miner (1998) uncovered a variety of distinctive improvisational competencies that developed as the organizations they studied gained experience in dealing with emergent problems and opportunities in specific areas of activity. Given these mechanisms, we expect the effect of improvisation on the outcome of responding to surprise events to be strengthened under conditions of high level of organizational age:

\[ H2b. \text{Improvisational responses to surprise events will generate better outcomes in older than in younger organizations.} \]

**Founder prior experience.** Since start-ups, by definition, are still in the early stages of accumulating their own collective organizational experience, they often call on the founding teams’ prior work experience as a form of supplemental and less broadly accessible memory to guide action in many areas (Baker et al., 2003; Beckman, 2006; Helfat & Lieberman, 2002; Phillips, 2002). In the context of new ventures, relevant founder experience has long been understood to have a positive association with new venture performance (Phillips, 2002). For example, Phillips (2002) found that the mobilization of partners in Silicon Valley law firms led to the transfer of routines from parent firms to progeny firms, which subsequently increased life chances of progeny firms.
An experienced founding team often equips the organization with a range of “industry recipes” (Carpenter & Westphal, 2001; Hambrick, Geletkanycz, & Fredrickson, 1993; Spender, 1989). This expands the firm’s repertoire of potential responses to surprise events (Mason & Harrison, 2006; Wright, Robbie, & Ennew, 1997), while perhaps somewhat increasing the challenges of accessing and integrating this knowledge while deploying it during improvised responses to surprise events. In addition, founder experience can provide rich frameworks and causal theories about appropriate responses to surprise events, which facilitates the categorization and interpretation of surprise events. In the area of entrepreneurship, observers have reported from empirical studies that founders’ prior experiences as employees and resulting cognitive “blueprints” strongly shape how their new organizations develop and adapt to a variety of challenges (Baron, Hannan, & Burton, 1999; Boeker, 1988). Taken together, these ideas and data imply that prior founder experience, as a supplementary organizational memory in start-ups, can enhance the outcome of organizations’ responding to surprise events.

*Hypothesis 3a: Organizations that include high levels of prior founder experience will generate better outcomes in response to surprise events than will the responses of younger organizations.*

**Prior founder experience and improvisation.** Following the similar logic of memory-contingent improvisation value, we argue that there is potentially positive effect of prior founder experience for the effect of improvisation on the outcome of responding to surprise events. Specifically, an experienced founding team may act as catalysts to derive value out of improvisational responses.

Under conditions of a high level of founder experience, firms can draw on founders’ prior skills or competencies that may act as crucial creative engines in improvisational responses (Miner et al., 2001). As note earlier, founders with extensive industry experience bring “blueprints” and “industry recipes” that become rich materials for creating novel responses.
through improvisation (Baker et al., 2003; Spender, 1989). This prior industry experience serves as useful “referents,” which been shown to be play an important role in maintaining coherence during the process of skillful collective improvisation (Miner et al., 2001). Prior founder experience thus helps translate and link improvisational actions to the established stock of knowledge resided in the founding team, thus enhancing its value in response to surprise events. This reasoning implies that in the presence of sufficient founder experience, we will expect an enhanced outcome out of improvisational responses.

In consistent with this line of argument, Hatch (1997) showed that the experience of a jazz band’s leader aids in recognizing cues, knowing when to shift emphasis among different players, and deciding in what direction to go next thereby creating a sense of collective coherence and improvisational skill. Prior studies have also suggested that among musicians, high levels of individual skills increase the speed and ease at which collective coordination and skilled improvisation can be created, (Berliner, 1994). We therefore hypothesize,

\[ H3b. \] Improvisational responses to surprise events will generate better (short term) outcomes in organizations with higher levels of founder experience than in organizations with lower levels of such experience.

METHODS

Sample

The unit of analysis in this study is the surprise event in a firm. Our sample consists of 141 surprise events described in interviews with 31 firms located in a Midwestern county. The sampling process involved two separate phases: (1) constructing a sample frame of knowledge-based firms and (2) deriving a sample of surprise events based on this sampling frame. The initial sampling frame from three primary sources: the Dun & Bradstreet database (n=19,645); a university start-up directory published by a major state university (n=178); and the Directory of High Technology Companies published by a local utility company (n=372) and supplemented by
interviewing with local experts (n=63). We then created a sample meeting our target for a study population of knowledge-based start-ups using sampling filters. The filters eliminated all firms that was more than five years old, and, because this study focuses on organizational level activities, all firms with fewer than 3 employees. We identified the Biotechnology & Drug sector (SIC 283), Information Technology (IT) industry (SIC 737), and Research, Development, and Testing Services (SIC 873) as important local industries for our study. We randomly selected 60 firms from the resulting sampling frame of 147 firms in these industries. Six of these firms refused to participate and we were not able to make contact with three others.

The interviews conducted in the resulting 60 knowledge-based firms consisted of 23 pilot interviews with experimental interview protocols and 37 interviews with the finalized protocol. We captured 235 potential surprise events from these 37 interviews. Of these, 141 surprise events from 31 organizations provided complete information for data analysis.

We used a multi-step process to create the sample of surprise events within these randomly selected firms. Using in-depth semi-structured interviews described below, we collected information regarding specific surprises and responses from company founders. The interviews were conducted in a two-step process. In the first part, founders were asked to tell the story of their business. The interview began with the following prompt/question: “There are a lot of myths out there about how small businesses work. To get beyond these myths, we are trying to learn more about founder’s day-to-day encounters with unexpected events. I’d like to hear the story of your business, beginning with how you came to start it. We are interested in the history of your company. As I wrote in my email, we especially interested in unexpected events. Let me remind you of the two examples we gave.” Responses to this question were followed-up by questions seeking to get descriptive detail on the specific the activities prior to and after each surprise event.
In the second part of the interview, the interviewer reviewed the surprises that the informant had identified during the interview. The informant then completed a brief written set of instruments regarding each surprise. In a post-interview verification phase, the initial surprises reported by informants and reviewed again by the informants at the end of the interview were reviewed by two independent raters not at the interview, but trained in applying the definition of a surprise used in this study. Table 2 outlines coding heuristics for this second process of surprise assessment.

-- Insert Table 2 about here --

Data collection process

The main raw data used for both time varying and time invariant variables was initially obtained through the interviews, with final measures developed using the steps detailed below. Pilot interviews were conducted to improve the initial protocol and to study how the interview materials affected respondents’ reporting behavior. Interview techniques followed standard qualitative practices (Denzin & Lincoln, 1998) to minimize retrospective and other bias. At least two and sometimes more members of the project team conducted each interview, with one member guiding the interview and the other taking notes and asking occasional clarification questions. A typical interview lasted 2.5-3 hours, with some lasting much longer. A professional transcription service transcribed all interviews.

As retrospective bias by informants is always a threat to validity in interview studies (Golden, 1992), we minimized this possibility by taking a number of safeguards. First, the interview data were collected from firm founders and founding teams, who were well-positioned to have firsthand knowledge about facts important to our study. Second, the effect of time was reduced to some extent by limiting the firms to those five or fewer years old. Third, the interview process followed “courtroom” procedure where respondents were directed to focus on concrete
facts and events rather than personal speculation (Birley, 1976; Eisenhardt 1989; Nisbet & Ross, 1980). Respondents were asked to date the events and construct the history of their business in chronological order, reducing the tendency to frame and interpret those events to fit their current view of the organization.

Social desirability could also threaten the systematic identification of surprise events. Some respondents might have perceived having any surprises as inconsistent with their administrative role of controlling the organization, assuming that they should be fully prepared to any business events. To minimize the effect of social desirability, we provided written confidentiality guarantees. Further, interviewers focused on the action sequences of events, avoiding hinting at any evaluation of any activity the respondent described.

**Dependent Variable**

The dependent variable, *Perceived Outcome*, was measured with a four-item 7-point Likert scale consisting of the following four questions: (1) The results of my company’s initial response to this surprise were satisfactory; (2) I am pleased with the results of my company’s initial response to this surprise; (3) I believe this surprise was handled well by my company; and (4) The results of our response to this surprise were good for the company. For each question, the response ranged from one being “Strongly Disagree” to four being “Neither Agree nor Disagree” to seven being “Strongly Agree”.

The scale was tested on a sub-sample of 50 responses from 8 companies. Pilot reliability assessment of the measure indicated an alpha of 0.870. Because respondents were required to fill out a written instrument for each surprise at the conclusion of the interview, reliable scales with fewer items were helpful to improve response rates. Removal of item 4 from the scale improved the alpha to 0.872, and so a final scale composed of the first 3 items was used. Using the final sample of 141 surprises, of the scale generate an alpha 0.907. Administering the written
instruments after all surprises had been discussed allowed respondents the opportunity to view their responses in relation to each other, and improves the accuracy of the assessment of the items by activating their memories before their written responses (Schwarz, Strack, & Mai, 1991; Tourangeau, Rasinski, Bradburn, & D'Andrade, 1989).

**Independent Variables**

**Improvisation.** This variable captures the degree of improvisation that characterized organizational behaviors just after the surprise event, and was coded by multiple raters who separately evaluated the improvisational nature of the organizations’ post surprise activities by reading transcripts of the interviews. The coding process involves two main steps: (1) identification of specific post-surprise actions, and (2) coding the degree to which these actions were improvisational.

In Step 1, two team members engaged in “line finding” related to behavioral responses to each surprise event. This involved identifying specific words, lines, or paragraphs of the transcript related to post-surprise behavior for a given surprise. The sets of lines identified in Step 1 were put in random order in terms of which transcripts they came from, and in terms of whether they represented pre or post surprise action. These randomized sets of lines from the transcripts were then given to the coders for Step 2. This randomization reduced the potential for bias should coders have views about specific firms or harbor tacit theories about how pre- and post-surprise behavior should differ (Schwab, 2004).

In Step 2, five raters coded the degree to which behaviors were improvisational based on their reading of the randomized transcript blocks produced in Step 1. Drawing on the improvisational scale from Moorman & Miner (1998), a preliminary coding scale for improvisation was developed for rating the post-surprise action mode. We followed an iterative process of pilot coding, scale refinement, and coding heuristic development. Table 3 shows the
final coding sheet. Note that non-improvised activity includes several distinct behavioral variations, such as following a routine, planning or following a plan. The inter-rater reliability of the five coders on action mode coding was deemed acceptable with an ICC(2,5) of 0.805.

-- Insert Table 3 about here --

**Firm age.** The variable was calculated from reported firm start date, allowing calculation of age at the time of the surprise event. *Firm Age* was scored as the number of months the organization had existed at the time the surprise event occurred.

**Founder experience.** The variable was measured as the logarithmic transformation of aggregated years of business experience of all founding team members, at the time the surprise occurred. Years of business experience was collected by asking the respondents how much business experience they and any founder not present at the interview had prior to starting their business and then adding the age of the company in years at the time of the surprise.

**Control Variables**

In addition to the theoretical variables described above, we included a number of control variables that prior theory or empirical evidence suggest might influence the outcome of responding to a surprise.

To control for industry effect, *Industry* is a dummy variable set equal to 1 if the firm operates in IT related industry, and 0 if it comes from biotechnology industry. To control for potential differences in improvisational patterns among firms of different sizes, *Firm Size* was measured as the logarithm transformation of the count of employees, on an annual basis. Respondents were given a chart and asked to write the number of employees who were employed at start-up and the beginning of each subsequent year. *Sufficient Time at Time of Surprise* and *Sufficient Money at Time of Surprise* were collected by asking founders to complete charts indicating quarterly adequacy of available material resources and available time. Having
slack resources of either time or funds may permit a greater number of feasible options in responses, and hence more valued responses (Eisenhardt & Tabrizi, 1995). To control for difference among founding teams, we included two variables related to founder background—

*Average Founder Education Level* and *Aggregated Founder Prior Start-ups*. To measure *Average Founder Education Level*, the level of education of each founder was collected and scored on an eight-point scale, (1 = some high school and 8 = at least one terminal degree) beyond) and the average computed. *Aggregated Founder Prior Start-ups*, was calculated as the total number of prior start-ups across all founders.

In addition to firm characteristics, we also controlled for some potentially important characteristics of the surprise events themselves. *Strategic Level of Surprise* captures the degree to which a surprise event is “strategic”. Consistent with prior use in the organizations literature (Ansoff, 1975; Winter, 2004), we define a surprise as being more strategic the more it involves the organization’s long term survival and prosperity, the more it in effect calls “into question its foundation premises about what to do” (Lengnick-Hall & Beck, 2005: 739). Surprises are less strategic when they involve threats or opportunities that appear likely to affect the organization in narrower or short term ways. Much of the organizations literature has also focused on strategic surprises as threatening events (Jauch & Kraft, 1986; Lampel & Shapira, 2001; Mintzberg, 1994), suggesting that the strategic level of surprise is negatively related to the perceived outcome. Respondents rated the *Strategic Level of Surprise* using a four item measure: (1) This surprise was important at the time to the company’s long-term survival and prosperity; (2) This surprise was not a key factor in the long-term survival and prosperity of the company (reverse coded); (3) This surprise affected the long-term survival and prosperity of the this company; and (4) This surprise distracted us from far more important activities. Respondents rated on a seven-point scale the degree to which they agreed to the above statements (1 = highly disagree; 7 =
highly agree). The inter-item alpha for this scale in a sub-sample was 0.679. We reviewed the items for construct validity and excluded Item 4, which generated a reliability of 0.832 on the subsample. Reliability for the three item scale on final sample of surprises was an inter-item alpha of 0.886.

The other surprise related variable Positive Surprise captures whether the surprise event is perceived as a positive event by the focal firm. Although both negative and positive surprises can theoretically produce valued or problematic outcomes, we expect that positive surprises should have a greater chance of generating good outcomes. To measure Positive Surprise, two independent raters reviewed the detailed descriptions of the surprise event in the interview transcript and field notes. Each coded whether a surprise was positive or negative. The coding process resulted in a 96% agreement between the two raters. The two raters discussed and reached agreements on the remaining 4% cases of surprise.

**Analysis**

We used Ordinary Least Square (OLS) regressions to test our hypotheses regarding outcomes to responses to surprise. We developed a data set in which each surprise event represents a case. One hundred forty-one surprise events were collected for which all necessary data were available, from thirty-one firms, yielding an average of 4.5 surprise events per organization. Using multiple observances within firms raises concerns about whether surprise events are independent. Consequently, we used “cluster” modeling techniques to accommodate any potential lack of independence between surprise events that occur within the same firm. Essentially, the “cluster” function generates robust standard errors adjusted for repeat observations by the same firm. For robustness check, we also ran linear mixed models, also known as hierarchical linear modeling (HLM) (Hofmann, Griffin, & Gavin, 2000; Kozlowski &
Klein, 2000). Models were run using HLM and no significant differences were observed compared to results from OLS. We report OLS results here.

RESULTS

Descriptives and model development. Table 4 presents descriptive statistics and correlations for all variables in the models. The bivariate correlation coefficients among some interaction variables were high, which raises the concern of multicollinearity. We performed a test to estimate the variance inflation factors (VIFs) of all variables and found that they were all well below 10, a conventional rule of thumb that is used to assess multicollinearity (Wooldridge, 2002). This exploratory procedure indicates that multicollinearity did not pose as a severe threat to the models in stake.

Table 5 reports the results of our regression analyses. Model 1 is a baseline that includes all control variables, while Model 10 represents the saturated model with all variables and relevant interactions. Because of the hypothetical interactions, our first step of assessing regression results lies in selecting the appropriate model to interpret the effects. To determine the contribution of individual interaction terms to the overall model fit, we estimated models by hierarchically adding interaction terms (Model 6 – 10). We evaluated the interaction terms under model fitness guidelines, with an emphasis on whether the addition of interaction terms significantly contribute to the improvement of model fit (Aiken and West 1991; Jaccard, Clark, & Golder, 1990). Across all models, Model 6 represents the most parsimonious model without losing the explanatory power. It shows significant improvements on model fit over the main effect Model 5 (Δ adjusted R^2 = 0.011, F = 4.32, p < .05). Further, Model 6 indicates a better model fit over Model 8-10, as the two interaction terms—Improvisation x Founder Experience and Improvisation Squared x Founder Experience—made little contribution to the overall model fit. Thus, we base our interpretations on Model 6.
While we base our interpretation on Model 6, it is noteworthy that the interaction term *Improvisation Squared x Firm age* is marginally significant ($\beta = 0.007, p < .10$) in Model 7, and it yields a marginally significant model improvement (Model 7: $\Delta$ adjusted $R^2 = 0.006, F = 4.20, p < .10$). We conducted robustness check on the basis of Model 7, which yields consistent results.

-- Insert Table 4 and 5 about here --

**Improvisation and perceived outcome (H1).** We proposed a U-shaped relationship between post-surprise improvisation and perceived outcome of responding to surprise events (H1). We find support for H1. We evaluated the hypothesized U-shaped relationship by two steps. First, the coefficient for *Improvisation* was negative and statistically significant ($\beta = -1.246, p < .01$) and its squared term was positive and statistically significant ($\beta = 0.127, p < .05$) in Model 6. These are based on a conservative two-tailed analysis. Put together, the two coefficients present preliminary evidence of a U-shaped relationship between post-surprise improvisation and the perceived outcome of responding to surprise events.

While the two coefficients provide initial support for H1, a more rigorous assessment of the relationship should consider whether the U-shaped relationship holds up at different levels of firm age, given the presence of the interaction term *Improvisation x Firm Age* in Model 6 ($\beta = 0.010, p < .05$). In this scenario, a simple “main effect” interpretation may lead to omission bias (Echambadi, Campbell, & Agarwal, 2007). Thus as the second step of evaluation, we plotted the effect of post-surprise improvisation on perceived outcome at different levels of firm age, i.e., one standard deviation above the mean, at the mean, and one standard deviation below the mean. Figure 1 illustrates the plotting results. The horizontal axis shows the range of values of post-surprise improvisation level; the vertical axis shows the perceived outcome. All three lines in Figure 1 point to a similar U-shaped pattern. This indicates an unconditional U-shaped
relationship between post-surprise improvisation and perceived outcome at different levels of firm age.

Results of the three coefficients, combined with the corresponding plotting, support the predicted U-shaped relationship between post-surprise improvisation and perceived outcome. A start-up’s perceived outcome improves when it shifts towards lower level (the left-hand tail) or higher level (the right-hand tail) of improvisation. In contrast, the perceived outcome declines when it engages at an intermediate level of improvisation, as reflected in the area around the trough of the curve. Overall, firms with pure non-improvisational response or pure improvisational response have a higher perceived outcome, while firms with a moderate level of improvisational response have a lower perceived outcome.

--- Insert Figure 1 about here ---

**Firm age and perceived outcome (H2a).** In Hypothesis 2a we predicted that firm age, as one type of organizational memory, will be positively related to perceived outcome because of the positive value embedded in organizational memory. H2a is not supported. Assessing the total effect of firm age on perceived outcome involves looking at the combined effect of two coefficients: The coefficient of *Firm Age* ($\beta = -0.060$, $p < .01$) and the coefficient of the interaction term *Improvisation* $\times$ *Firm Age* ($\beta = 0.010$, $p < .05$). The significant, negative coefficient for *Firm Age* rejects an unconditional positive value of memory as hypothesized in H2a.

**Improvisation and firm age (H2b).** Hypothesis 2b predicted that firm age will increase the potential value of improvisation on perceived outcome. H2b is supported. To test this hypothesis, we first start with an assessment of the model fit improvements with the added interaction term. As noted, adding the interaction term *Improvisation* $\times$ *Firm Age* significantly improves model fit over Model 5 that only include main effects (Model 6: $\Delta$ adjusted $R^2 = 0.011$,
F = 4.32, p<.05). This presents initial evidence of the existence of interaction effect. At the same time, the coefficient for the interaction term is significant and follows the hypothesized direction (β = 0.594, p < .05), providing further support to a positive interaction between post-surprise improvisation and firm age.

To further probe the nature of the interaction effect, we conducted marginal effect analysis of the two variables involved. Appendix A contains the corresponding partial derivative equations for all conditional analyses, following standard treatments of interaction models (Aiken & West, 1991; Brambor, Clark, & Golder, 2005; Jaccard et al., 1990). We calculated estimates of the change in perceived outcome given a marginal change (one standard deviation) in post-surprise improvisation and firm age, as follows:

\[
\begin{align*}
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{low}, \text{AGE}=\text{low} \bigg. = -0.601^{**} (0.172) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{low}, \text{AGE}=\text{mean} \bigg. = -0.447^{*} (0.166) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{low}, \text{AGE}=\text{high} \bigg. = -0.293 (0.190) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{mean}, \text{AGE}=\text{low} \bigg. = -0.292^{*} (0.100) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{mean}, \text{AGE}=\text{mean} \bigg. = -0.138 (0.092) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{mean}, \text{AGE}=\text{high} \bigg. = 0.159 (0.133) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{mean}, \text{AGE}=\text{high} \bigg. = 0.170 (0.127) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{high}, \text{AGE}=\text{low} \bigg. = 0.016 (0.127) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{high}, \text{AGE}=\text{mean} \bigg. = 0.170 (0.123) \\
\frac{\partial \text{OUTCOME}}{\partial \text{IMP}} & \bigg| \text{IMP}=\text{high}, \text{AGE}=\text{high} \bigg. = 0.324^{*} (0.158)
\end{align*}
\]

These conditional analyses show that post-surprise improvisation has a significant negative effect on perceived outcome, when both post-surprise improvisation and firm age are at low or medium levels (β = -0.601, p < .01; β = -0.447, p < .05; and β = -0.292, p < .01). It has a significant positive effect on perceived outcome when both post-surprise improvisation and firm age are at high levels (β = 0.324, p < .05).

As an interaction effect represents the joint impact of two variables, we also conducted conditional analysis on the effect of firm age on perceived outcome. This revealed consistent support for a positive moderating effect of post-surprise improvisation on the value of firm age.
These findings support the positive interaction effect between post-surprise improvisation and firm age as hypothesized in H3a.

Figure 2 depicts the marginal impact of firm age on perceived outcome. The vertical axis of the Figure 2 represents the marginal effect of firm age on perceived outcome; the horizontal axis represents post-surprise improvisation within the full data range. Figure 2 indicates that at low level of improvisation, firm age has a strong negative effect on perceived outcome (also see Appendix A: $\beta = -0.038$, $p < .01$). This negative effect declines as the level of post-surprise improvisation increases. At the high end of improvisation firm age no longer has a significant reductive impact on perceived outcome (Also see Appendix A: $\beta = -0.014$, $p > .05$). Figure 2 underscores that the impact of post-surprise improvisation and firm age are not merely additive, but that the impact of each is enhanced by the presence of the other.

--- Insert Figure 2 about here ---

**Founder experience and perceived outcome (H3a).** Hypothesis 3a predicted that prior founder experience, as supplementary organizational memory, is positively related to perceived outcome. H3a is supported. There is no significant interaction effect found for improvisation and founder experience. As a consequence it is appropriate to assess this variable using the simple coefficient of *Founder Experience*. Consistent with our prediction, prior founder experience at time of surprise has a significant, positive effect on perceived outcome ($\beta = 0.594$, $p < .05$). Founding teams with a higher level of experience have a higher perceived outcome, compared to those with more limited prior experience.

**Improvisation and founder experience (H3b).** We proposed that post-surprise improvisation will have a stronger effect when there is presence of high level of prior founder experience (H3b). This is not supported. As noted, Model 8 and 9 includes two interaction terms,
Improvisation x Founder Experience and Improvisation Squared x Founder Experience. These two terms did not yield a significant contribution to model fit.

**Baseline model.** Although our focus is on the theory driven variables, we examined the baseline model as well. Average founder education level was also negatively related to perceived outcome to surprise responses ($\beta = -0.297, p < .01$). The other controls are unrelated to perceived outcome.

**Robustness check on model selection.** As a robustness check, we conducted separate marginal effect analysis of post-surprise improvisation and age on perceived outcome, on the basis of Model 7. We further visually depict the marginal impact of firm age on perceived outcome in Figure 3. The vertical axis of the Figure 3 is the marginal effect of firm age on perceived outcome; the horizontal axis represents post-surprise improvisation within the full data range. Figure 3 indicates that at low level of improvisation, firm age has a strong reductive effect on perceived outcome. This reductive effect declines as the level of post-surprise improvisation increases to a medium level. At the medium and high levels of post-surprise improvisation the reductive effect of firm age on response is no longer significant. The overall marginal effect pattern of firm age is consistent with Figure 2 that is based on Model 6.

DISCUSSION

Our study proposes that improvisation and organizational memory play a key role in what happens after an organization responds to a specific surprise. We argued that the degree of improvisation has a curvilinear impact on perceived outcome, and the presence of organizational memory will influence the chances that an improvisational response will generate an outcome valued by the organization. Taken as whole, our study supports our framework, but also presents important puzzles and issues for further work. We first discuss the specific findings for our
hypotheses, and then consider rival interpretations of results and study limitations. We conclude by considering implications of our work for the broader landscapes of research on organizational surprise.

**Improvisation and Perceived outcome**

Our results for improvisation provide a more nuanced understanding of the value of improvisation in a surprise response context. Consistent with prior research on improvisation, sticking to modes of planning and executing plans, or drawing on prior routines in the response produced better outcomes than mixing some improvisation with using planning and routines (Moorman & Miner, 1997). If an organization operates in a setting with some stability, and has had time to develop action routines and planning capabilities, then in general improvisation – or any novel action – is on average a bad bet. A subset of novel actions will be beneficial but the overall expected value should be negative (March, 1991).

However, our study provides important evidence that improvisation can offer value in surprise conditions. Prior quantitative studies of improvisation have raised doubt about its value. At the same time, prior qualitative studies gave vivid examples of improvisational activity that avoided death in the presence of a fire-wall (Weick, 1993), re-interpreted rules to permit positive activity during a strike (Preston, 1991), sustained a distributed navigation process (Hutchins, 1991), and responses to problems and unexpected opportunities in new product development (Miner et al., 2001). Our results are consistent with the notion that improvisation may have more value specifically in the context of surprises, than in a more general way.

In addition, we theorized that this is especially likely in the start-up setting because if the greater chances of focused attention on the improvisational activity and greater potential for coordination linked to incoming real-time information and knowledge (Moorman & Miner, 1998). For any firm, a surprise presumably represents a valid indicator that the organization
faces a changing context, or has an incomplete or incorrect set of automatic responses, making some form of novel activity – including improvisation – potentially valuable (Mendonca, 2005; Weick, 1993). The organization can stop and plan, but in many cases start-ups have fewer planning resources, may have less resource buffers to deal with threats, making urgent action more important. The fusion of designing and executing action, if informed with other knowledge, can have value in this setting (Baker & Nelson, 2005; Gong et al., 2004).

**Organizational Memory and Improvisation**

We proposed that greater organizational memory will enhance the chances that a perceived outcome will have value to the organization. We had theorized that both firm age and prior founder experience can provide valuable structure and knowledge for a new venture’s responding to surprises. Findings for the impact of founder related experience are consistent with our theory. However, we did not find that firm age enhanced the value of perceived outcomes. Instead, firm age is found negatively correlated with perceived outcome. We speculate that the actual knowledge deployed in dealing with surprises may draw more on founder experience rather than on the formal structure and routines that are accompanied by organizational inertia and rigidity. A post hoc analysis of the specific descriptions of individual surprises seemed consistent with this conclusion. Many surprises seemed to be idiosyncratic to a firm’s specific context, rather than representative of a class of surprises that may frequently occur in start-ups.

We proposed a conditional framework of improvisation value. We had theorized that the presence of organizational memory will enhance improvisational value in response to surprise. Findings for the interaction between organizational memory and improvisation are consistent with our theory. When both firm age and improvisation are at high levels, organizations are more likely to drive valuable perceived outcomes out of improvisational actions. This implies that improvisation can actually serve as an effective antidote to organizational rigidity and inertia.
Thus, our theory and setting offer more precise ideas about boundary conditions for when improvisation can have a net positive impact.

Although our results are generally consistent with our predictions about how different types of knowledge challenges influence the outcomes of surprise responses, some of our theoretical and baseline results deserve further exploration. We found differential impacts from the two types of organizational memory – firm age and prior founder experience. Further work could seek to examine the impact of different types of organizational memory in response to unexpected events. We also found that more highly educated founding teams tended to have less valuable perceived outcomes, which seems counterintuitive. Our sample included some university-linked start-ups; one potential interpretation of this finding is that faculty founding teams were less likely to have business capabilities to respond to business surprises. However, this somewhat counterintuitive result deserves further exploration.

**Rival Interpretations and Study Limitations**

Our study design contains several powerful features that help avoid potential dangers such as common methods variance and results arising from informants’ trying to comply with social norms. The identification of surprises was done by informants, but checked against definitions by later objective researchers. The informants did not hear the word improvisation or engage in discussions of their ideas about factors that will influence responses to surprises. Informants rated the outcomes of their responses to surprises, while most variables in the causal model were derived from objective fact sheets reporting items like founder experience or organizational size. Finally, the coding of levels of improvisation in the actual response activities occurred long after the interviews, and was done by raters reading randomized units of text drawn from 1,725 pages of transcripts. The raters did not know whether they were rating a pre-surprise or post-surprise action, reducing the chances that *their* tacit ideas about improvisation...
and outcomes would impact results. These study design features strongly reduce the chances that the pattern of results arises from common methods variance or social desirability effects.

One important question that does arise is whether theories about cognitive processes related to surprise could account for the pattern of our findings. Several important literatures imply that decision makers who observe the outcome of their decisions will tend to be disappointed: better results will be systematically expected than are obtained (Harrison & March, 1984). Our setting does not fully correspond to the standard set-up for this causal model, which focuses prior deliberate choice followed by specific related outcomes. Nonetheless, one could argue that when the start-ups respond to the surprise, this can itself be conceptualized as a ‘decision’ and their perceived outcome the product of this decision. If the standard disappointment process were in effect, the organizational ratings of perceived outcomes should on average be negative. In our data, this did not occur. The mean rating of outcomes was slightly above neutral. The general pattern of the perceived value of outcomes, then, cannot be explained through the prior work on post-decision disappointment.

Implications: Organizational surprises. Surprises can lead to organizational actions that directly influence a firm’s well being. Our study advances theory about organizational surprises by studying this crucial area directly. Although our sample included both positive and negative surprises, the majority were negative, so our evidence has more relevance to negative surprises. Therefore the adaptation in question relates primarily to adaptation to threats or negative changes.

Our work complements three lines of work on surprises that focus on different aspects of the potential chain of surprises related activities. Much important work arises in the long history in the military and political strategy literatures, where encountering a strategic surprise is commonly viewed as a strongly negative event (Byman, 2005; Chan, 1979; Handel, 1984;
Mahnken, 1999). Our work moves from the issue of avoiding surprises to directly responding to surprise, an important area worthy of attention. Our work also complements but is distinct from the important emerging research on the cognitive contrast between the original expectations and the revealed world as shown in the surprise event as a driver for changes in cognitive maps of the world (Stiensmeier-Pelster et al., 1995). In that context, theorists envision surprise as one of the most powerful engines for long-term learning: surprise events reveal weaknesses or incompleteness in prior models of reality. Exploring their origins offers a chance to develop more accurate models of the world (Cohen & Axelrod, 1984; Gavetti & Levinthal, 2001).

Our study contributes in a different way to long-term learning models that emphasize more behavioral change rather than shifts in cognitive states. A surprise can stimulate organization to try several novel behaviors, even though it does not directly revise the organization’s cognitive map. The surprise event and its recognition can “unfreeze” an organization and new behaviors or changes in action may occur (Edmondson, Bohmer, & Pisano, 2001; Lewin, 1947). Our study provides a framework to predict the outcome of a response to the surprise – which then becomes a ‘trial’ and its outcome for such long-term trial and error learning (Miner et al., 2001).

Finally, the literatures on strategic change suggest that unexpected threats or opportunities may lead to broad changes in organizational strategy or behavior (Edmondson et al., 2001; Huff, Huff, & Thomas, 1992; Meyer, 1982). Environmental jolts (Meyer, 1982; Sine & David, 2003), interruption (Zellmer-Bruhn, 2003), threat (Staw et al., 1981), and crisis (Kim, 1998; Lin et al., 2006) all offer contexts where surprise events may occur. Our work complements and extends this general body of work because we examine the outcomes of an organization’s specific response to a given surprise. Our approach implies that fairly local conditions in terms of the organization’s own memory, the strategic level of the surprises and the
degree of improvisation during a given response can play a role in the outcomes of responses. These in turn may influence the long-term trajectories of adaptation. Exploring such possibilities offers an important next step in research on knowledge deployment and organizational surprises.
REFERENCES


**TABLE 1**

<table>
<thead>
<tr>
<th>Surprise ID</th>
<th>Surprise Event</th>
<th>Page: Line</th>
<th>Related Texts in Interview Transcripts</th>
<th>Positive or Negative</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCH02</td>
<td>Former employee threatened to put code on Internet</td>
<td>8:12</td>
<td>So, he leaves, he calls up a week later and says, you know, you were really underpaying me. Right. That’s capitalism, you know, profiting from the labor . . . so I’m going to put your code on the Internet. So, then the FBI got involved in that, and that was a disaster.</td>
<td>N</td>
<td>HR</td>
</tr>
<tr>
<td>SCH01</td>
<td>Software glitch</td>
<td>4:34</td>
<td>We were crashing communications and police networks around the country, had to give people back their money. It was just disaster. So, that was within a year of incorporating. We should pretty much have rationally packed it in.</td>
<td>N</td>
<td>Technical</td>
</tr>
<tr>
<td>ABS02</td>
<td>Lost deal</td>
<td>23:23</td>
<td>So, we thought we’d get that deal for sure. And he said, well, we’re merging. And I said, okay, well, that’s fine. You’re going to merge with a new company and it’s a big company, I said, but you’re sure you still have an okay on this project? Yes, yes, yes, we’re fine. Sure as shit, they merged, no deal. The real holders of the new company had a brother-in-law or somebody who could do it.</td>
<td>N</td>
<td>Client Relationship</td>
</tr>
<tr>
<td>INF01</td>
<td>False reporting of pregnancy</td>
<td>8:12</td>
<td>We started out with an initial collaborator in the University who was supposed to be a reproduction specialist ... It was very hard to keep them focused on what we needed to accomplish. ... Then we had a false reporting of a pregnancy in the summer by them ... Which actually turned out their own sloppy recordkeeping. They reported it as a possible pregnancy of a nuclear transfer embryo and it turned out the boar had bred her. Quite a big difference.</td>
<td>N</td>
<td>Partnership</td>
</tr>
<tr>
<td>IST01</td>
<td>Competitor pricing cut</td>
<td>34:22</td>
<td>After the fourth quarter last year they were really in pain. I mean, all the component companies were feeling a lot of pain. But Comp chose to deal with that by drastically lowering their consulting bill rates. I mean, like where they were chopping them in half. I mean, they were going from eighty some dollars an hour to $40 an hour. And they started doing things like, if you bring in this consultant we'll give you this consultant for free. And it's like, all right, what do you do with that? I mean, so. That was unexpected.</td>
<td>N</td>
<td>Competition</td>
</tr>
<tr>
<td>MAT01</td>
<td>At Link goes out of business</td>
<td>19:28</td>
<td>And At Link went out of business in April of last year. So, we dealt with the partners leaving, and then two months later, At Link goes into bankruptcy and everybody turns off their pipes. And then suddenly we have no Internet access in our office.</td>
<td>N</td>
<td>Operational</td>
</tr>
<tr>
<td>LUH01</td>
<td>Acquired major client</td>
<td>4:04</td>
<td>Yeah. I mean, a lot of, well, one major client was, you know, totally unexpected. You know what I mean? I mean, we didn’t really have a marketing plan per se, so we kind of try to do our thing. But, in any case, you know, we’re just sitting there one day and this call comes and somebody says, hey, you know, you guys might be interested in this. We go over there, and like three days later we have this contract, you know, a big one, relatively speaking. You know what I mean? And so it's like, well, oh good, you know what I mean, but it was very random. It wasn’t at all planned.</td>
<td>P</td>
<td>Sales</td>
</tr>
</tbody>
</table>
### TABLE 2 - Coding Heuristics for Identifying Surprise

<table>
<thead>
<tr>
<th>Definitions</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition of surprise</strong></td>
<td><strong>A surprise is an event that is subjectively recognized as unexpected.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Expansion:</strong> This may happen when some outcome is anticipated, and the actual outcome differs from the anticipation. The difference might be positive, negative, or neutral. A surprise may also occur when there was no conscious anticipation of a particular outcome other than an expectation that things would continue unchanged.</td>
</tr>
<tr>
<td><strong>Process of surprise identification</strong></td>
<td><strong>The first identification of surprises was done by informants during substantial interviews.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>During each interview, the informant identifies surprises in “real time”, and interviewer writes a description of each surprise on a data sheet. To identify surprises for later coding, coders first look at the surprises on the interview survey. Coders then read through the transcript to find the text that describes the data sheet surprises. Coders then decide if the text, in fact, provides evidence of a surprise as defined above. For now, we will disregard other things that may seem like surprises that may be identified in the coding process.</strong></td>
</tr>
<tr>
<td><strong>It’s a surprise if</strong></td>
<td><strong>Includes instances where expectations are directly stated, and an opposing occurrence (or fact that indicates an opposing occurrence) is indicated – regardless of the interviewee(s) awareness of this as a surprise.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Includes instances where expectations are diffuse (i.e. if one expects the status quo but the status quo is disrupted).</strong></td>
</tr>
<tr>
<td><strong>It’s tied to a specific event, or is a specific event.</strong></td>
<td><strong>Includes instances where a more specific surprise is embedded within a larger surprise. We are particularly interested in identifying technical and scientific surprises embedded within other surprises.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>“We found out he wasn’t as good as maybe he thought he was, or anybody else” (1st surprise, InfTech 8:14) “They reported it as a possible pregnancy of a nuclear transfer…and it turned out the boar had bred her” (another, more specific embedded in 1st surprise)</strong></td>
</tr>
<tr>
<td><strong>Surprises are not</strong></td>
<td><strong>Subjective perceptions of knowledge gained and “lessons learned” that respondents indicate has surprised them over the course of doing business.</strong></td>
</tr>
<tr>
<td><strong>Lessons learned</strong></td>
<td><strong>“We realized the best way to find clients is through networking”. Or “We were surprised how easy it is to incorporate”</strong></td>
</tr>
<tr>
<td><strong>Pattern recognition</strong></td>
<td><strong>Respondent indicates a general pattern noticed over time.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>“we’ve found is there are a lot of state contracts that you can get and a lot of them are what, you know, some people called wired)”</strong></td>
</tr>
<tr>
<td><strong>Uncertain results versus unexpected events.</strong></td>
<td><strong>Events that occur after uncertainty is expressed versus an indication of violated expectations (or no prior expectation).</strong></td>
</tr>
<tr>
<td></td>
<td><strong>“We had negotiations going on …two of them simultaneously. It’s kind of a horse race to see who we’d end up with, or who would end up with us…We ended up working with” (one of the firms negotiation with).</strong></td>
</tr>
<tr>
<td><strong>Instances where teams violates their own plan.</strong></td>
<td><strong>This confuses a surprise with a behavioral change, and it potentially confuses a surprise with the dependent variable.</strong></td>
</tr>
<tr>
<td><strong>There is not enough information to code pre or post behavior</strong></td>
<td><strong>This type of surprise can be identified as “not codable”</strong>.</td>
</tr>
</tbody>
</table>
### TABLE 3

**Coding Scale of Improvisation**

<table>
<thead>
<tr>
<th>Coding Scale of Improvisation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Improvisation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Much</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Improvisation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Pure planning**
- **Pure execution of a plan or routine**
- “Action followed a strict plan/routine as it was taken.”
- “Strictly followed out plan in carrying out this action.”
- Negligible
- Loose planning and/or loose execution
- Cannot rule out improvisation
- More Non improvisation than improvisation
- Glimmer of improvisation
- Balance of improvisation and non improvisation
- More improvisation than non improvisation
- Much more improvisation than non improvisation
- Significant amount of improvisation
- Full improvisation
- “Made it up as they went along.”
- “Figured out action as they went along.”
- “Ad-libbed action.”

**ICC(2,5) = .805**
### TABLE 4

Descriptive Statistics and Correlations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>S D</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Outcome of Surprise Response</td>
<td>0.91</td>
<td>1.57</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2. Industry</td>
<td>0.92</td>
<td>0.27</td>
<td>0.05</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Firm Size</td>
<td>1.93</td>
<td>1.00</td>
<td>0.05</td>
<td>-0.10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sufficient Time at the Time of the Surprise</td>
<td>3.52</td>
<td>1.80</td>
<td>0.11</td>
<td>-0.16*</td>
<td>0.05</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Sufficient Money at the Time of the Surprise</td>
<td>3.56</td>
<td>1.59</td>
<td>0.09</td>
<td>-0.10</td>
<td>0.27**</td>
<td>0.46**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Industry</td>
<td>0.92</td>
<td>0.27</td>
<td>0.05</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>7. Firm Size</td>
<td>1.93</td>
<td>1.00</td>
<td>0.05</td>
<td>-0.10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Average Founder Education Level</td>
<td>4.61</td>
<td>2.04</td>
<td>-0.17*</td>
<td>0.00</td>
<td>0.13†</td>
<td>0.04</td>
<td>0.02</td>
<td>1</td>
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<td></td>
<td></td>
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<tr>
<td>9. Aggregated Founder Prior Start-ups</td>
<td>1.86</td>
<td>2.47</td>
<td>-0.04</td>
<td>0.23**</td>
<td>-0.08</td>
<td>0.04</td>
<td>0.10</td>
<td>0.19**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Positive Surprise</td>
<td>0.76</td>
<td>1.68</td>
<td>-0.07</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.05</td>
<td>-0.23**</td>
<td>0.10</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11. Strategic Level of Surprise</td>
<td>0.11</td>
<td>0.31</td>
<td>0.18*</td>
<td>0.10</td>
<td>0.02</td>
<td>0.00</td>
<td>0.04</td>
<td>0.04</td>
<td>0.02</td>
<td>0.18*</td>
<td>1</td>
</tr>
<tr>
<td>12. Positive Surprise</td>
<td>0.76</td>
<td>1.68</td>
<td>-0.07</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.05</td>
<td>-0.23**</td>
<td>0.10</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13. Positive Surprise</td>
<td>0.76</td>
<td>1.68</td>
<td>-0.07</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.05</td>
<td>-0.23**</td>
<td>0.10</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>14. Positive Surprise</td>
<td>0.76</td>
<td>1.68</td>
<td>-0.07</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.05</td>
<td>-0.23**</td>
<td>0.10</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>15. Positive Surprise</td>
<td>0.76</td>
<td>1.68</td>
<td>-0.07</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.05</td>
<td>-0.23**</td>
<td>0.10</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>16. Positive Surprise</td>
<td>0.76</td>
<td>1.68</td>
<td>-0.07</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.05</td>
<td>-0.23**</td>
<td>0.10</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>17. Positive Surprise</td>
<td>0.76</td>
<td>1.68</td>
<td>-0.07</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.05</td>
<td>-0.23**</td>
<td>0.10</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

* n = 141.
† p < .10
* p < .05
** p < .01
TABLE 5
Ordinary Least Square Models with Outcomes of Responses to Surprises as the Dependent Variable

<table>
<thead>
<tr>
<th>MODEL 1</th>
<th>MODEL 2</th>
<th>MODEL 3</th>
<th>MODEL 4</th>
<th>MODEL 5</th>
<th>MODEL 6</th>
<th>MODEL 7</th>
<th>MODEL 8</th>
<th>MODEL 9</th>
<th>MODEL 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.500*</td>
<td>2.940*</td>
<td>4.362**</td>
<td>1.261</td>
<td>2.855†</td>
<td>4.041*</td>
<td>5.877**</td>
<td>3.753*</td>
<td>4.443**</td>
</tr>
<tr>
<td>(1.144)</td>
<td>(1.215)</td>
<td>(1.210)</td>
<td>(1.467)</td>
<td>(1.393)</td>
<td>(1.456)</td>
<td>(1.785)</td>
<td>(1.608)</td>
<td>(1.424)</td>
<td>(1.855)</td>
</tr>
<tr>
<td>Industry</td>
<td>-0.724</td>
<td>-0.766</td>
<td>-0.737</td>
<td>-0.859</td>
<td>-0.843</td>
<td>-0.876</td>
<td>-0.815</td>
<td>-0.819</td>
<td>-0.826</td>
</tr>
<tr>
<td>(0.703)</td>
<td>(0.684)</td>
<td>(0.688)</td>
<td>(0.772)</td>
<td>(0.771)</td>
<td>(0.819)</td>
<td>(0.769)</td>
<td>(0.764)</td>
<td>(0.767)</td>
<td>(0.784)</td>
</tr>
<tr>
<td>Firm Size</td>
<td>0.307</td>
<td>0.305</td>
<td>0.270</td>
<td>0.318†</td>
<td>0.278</td>
<td>0.267</td>
<td>0.246</td>
<td>0.270</td>
<td>0.270</td>
</tr>
<tr>
<td>(0.219)</td>
<td>(0.224)</td>
<td>(0.216)</td>
<td>(0.218)</td>
<td>(0.183)</td>
<td>(0.180)</td>
<td>(0.170)</td>
<td>(0.182)</td>
<td>(0.184)</td>
<td>(0.166)</td>
</tr>
<tr>
<td>Sufficient Time at the Time of the Surprise</td>
<td>0.070</td>
<td>0.068</td>
<td>0.079</td>
<td>0.119</td>
<td>0.109</td>
<td>0.126</td>
<td>0.098</td>
<td>0.126</td>
<td>0.127</td>
</tr>
<tr>
<td>(0.112)</td>
<td>(0.109)</td>
<td>(0.106)</td>
<td>(0.103)</td>
<td>(0.099)</td>
<td>(0.093)</td>
<td>(0.092)</td>
<td>(0.100)</td>
<td>(0.101)</td>
<td>(0.091)</td>
</tr>
<tr>
<td>Sufficient Money at the Time of the Surprise</td>
<td>0.027</td>
<td>0.015</td>
<td>0.008</td>
<td>-0.019</td>
<td>-0.031</td>
<td>-0.046</td>
<td>-0.047</td>
<td>-0.031</td>
<td>-0.033</td>
</tr>
<tr>
<td>(0.125)</td>
<td>(0.119)</td>
<td>(0.117)</td>
<td>(0.107)</td>
<td>(0.104)</td>
<td>(0.106)</td>
<td>(0.109)</td>
<td>(0.104)</td>
<td>(0.104)</td>
<td>(0.098)</td>
</tr>
<tr>
<td>Average Founder Education Level</td>
<td>-0.375*</td>
<td>-0.381*</td>
<td>-0.364*</td>
<td>-0.297**</td>
<td>-0.283**</td>
<td>-0.297**</td>
<td>-0.284**</td>
<td>-0.283**</td>
<td>-0.278**</td>
</tr>
<tr>
<td>(0.134)</td>
<td>(0.133)</td>
<td>(0.129)</td>
<td>(0.106)</td>
<td>(0.097)</td>
<td>(0.095)</td>
<td>(0.093)</td>
<td>(0.096)</td>
<td>(0.098)</td>
<td>(0.097)</td>
</tr>
<tr>
<td>Aggregated Founder Prior Start-ups</td>
<td>-0.010</td>
<td>-0.013</td>
<td>0.001</td>
<td>-0.113</td>
<td>-0.112</td>
<td>-0.116*</td>
<td>-0.100</td>
<td>-0.103</td>
<td>-0.103*</td>
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<tr>
<td>(0.052)</td>
<td>(0.051)</td>
<td>(0.051)</td>
<td>(0.071)</td>
<td>(0.068)</td>
<td>(0.067)</td>
<td>(0.066)</td>
<td>(0.068)</td>
<td>(0.071)</td>
<td>(0.069)</td>
</tr>
<tr>
<td>Strategic Level of Surprise</td>
<td>-0.129</td>
<td>-0.129</td>
<td>-0.122</td>
<td>-0.176</td>
<td>-0.180</td>
<td>-0.180*</td>
<td>-0.171</td>
<td>-0.168</td>
<td>-0.185*</td>
</tr>
<tr>
<td>(0.113)</td>
<td>(0.113)</td>
<td>(0.116)</td>
<td>(0.108)</td>
<td>(0.105)</td>
<td>(0.097)</td>
<td>(0.107)</td>
<td>(0.105)</td>
<td>(0.098)</td>
<td></td>
</tr>
<tr>
<td>Positive Surprise</td>
<td>0.808</td>
<td>0.786</td>
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<td>0.513</td>
<td>0.536</td>
<td>0.528</td>
<td>0.532</td>
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<tr>
<td>(0.505)</td>
<td>(0.507)</td>
<td>(0.503)</td>
<td>(0.415)</td>
<td>(0.415)</td>
<td>(0.406)</td>
<td>(0.395)</td>
<td>(0.413)</td>
<td>(0.413)</td>
<td>(0.397)</td>
</tr>
<tr>
<td>Improvisation</td>
<td>-0.092</td>
<td>-1.022**</td>
<td>-0.965*</td>
<td>-1.246**</td>
<td>-2.426**</td>
<td>-1.251*</td>
<td>-1.725*</td>
<td>-2.093*</td>
<td>0.007*</td>
</tr>
<tr>
<td>(0.094)</td>
<td>(0.325)</td>
<td>(0.353)</td>
<td>(0.367)</td>
<td>(0.789)</td>
<td>(0.489)</td>
<td>(0.890)</td>
<td>(0.101)</td>
<td>(0.137)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Improvisation Squared</td>
<td>0.126*</td>
<td>0.124*</td>
<td>0.127*</td>
<td>0.279**</td>
<td>0.198</td>
<td>0.244*</td>
<td>0.105*</td>
<td>0.061*</td>
<td>0.066*</td>
</tr>
<tr>
<td>(0.041)</td>
<td>(0.046)</td>
<td>(0.047)</td>
<td>(0.047)</td>
<td>(0.047)</td>
<td>(0.047)</td>
<td>(0.047)</td>
<td>(0.047)</td>
<td>(0.047)</td>
<td>(0.047)</td>
</tr>
<tr>
<td>Firm Age</td>
<td>-0.052*</td>
<td>-0.060**</td>
<td>-0.066**</td>
<td>-0.146**</td>
<td>-0.023*</td>
<td>-0.157**</td>
<td>0.007*</td>
<td>0.223</td>
<td>-0.007*</td>
</tr>
<tr>
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<td>(0.011)</td>
<td>(0.013)</td>
<td>(0.043)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Founder Experience</td>
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<td>0.584*</td>
<td>0.594*</td>
<td>0.634*</td>
<td>0.338</td>
<td>0.933</td>
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<td>0.223</td>
<td>-0.085</td>
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<tr>
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<td>(0.243)</td>
<td>(0.236)</td>
<td>(0.380)</td>
<td>(0.384)</td>
<td>(0.385)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.052)</td>
</tr>
<tr>
<td>Improvisation x Firm Age</td>
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<td>0.070</td>
<td>0.066*</td>
<td>0.212</td>
<td>0.197</td>
<td>0.191</td>
<td>0.207</td>
<td>0.212</td>
<td>0.218</td>
</tr>
<tr>
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<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.043)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Improvisation Squared x Firm Age</td>
<td>-0.022</td>
<td>0.012</td>
<td>0.012</td>
<td>0.062</td>
<td>0.068</td>
<td>0.062</td>
<td>0.084</td>
<td>0.062</td>
<td>0.068</td>
</tr>
<tr>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.043)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Improvisation x Founder Experience</td>
<td>0.069</td>
<td>0.223</td>
<td>-0.012</td>
<td>0.062</td>
<td>0.068</td>
<td>0.062</td>
<td>0.084</td>
<td>0.062</td>
<td>0.068</td>
</tr>
<tr>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.043)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Improvisation Squared x Founder Experience</td>
<td>-0.022</td>
<td>0.012</td>
<td>0.012</td>
<td>0.062</td>
<td>0.068</td>
<td>0.062</td>
<td>0.084</td>
<td>0.062</td>
<td>0.068</td>
</tr>
<tr>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.043)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
</tbody>
</table>

Notes:† p < .10; * p < .05; ** p < .01 (two-tail tests). Standard errors are adjusted for clustering on firms.
FIGURE 1
Predicted Second-order Improvisation Effect on Perceived outcome
FIGURE 2
The Marginal Effect of Firm Age on Perceived Outcome
(Based on Model 6)
FIGURE 3
The Marginal Effect of Firm Age on Perceived Outcome
(Based on Model 7)
APPENDIX A
Partial Derivative of Interaction Models

The investigation of conditional effects in models containing interaction terms is based on the corresponding partial derivative of the full model that includes the interaction term. The following section outlines the derivative equations used to calculate regression coefficient estimates for different values of moderator variables (Brambor et al., 2006; Cohen et al., 2003). The fully specified Model 6 is:

\[ y_i = \beta_0 + \beta_1 IMP_i + \beta_2 IMP_i^2 + \beta_3 AGE_i + \beta_4 IMP_i \cdot AGE_i + BASELINE + \varepsilon_i \] (1)

Marginal effect of improvisation on outcome. The change in the dependent variable Surprise Perceived outcome for a marginal change of Post-surprise Improvisation for firm \( i \) is:

\[ \frac{\partial y_i}{\partial IMP_i} = \beta_1 + 2\beta_2 IMP_i + \beta_4 AGE_i \] (2)

Standard errors of the marginal change can be derived with the following formula:

\[ \hat{\sigma}^2 \frac{\partial y_i}{\partial IMP_i} = \text{var}(\hat{\beta}_1) + 4IMP_i^2 \text{var}(\hat{\beta}_2) + \text{var}(\hat{\beta}_3) + 4IMP_i \text{cov}(\hat{\beta}, \hat{\beta}_2) + 2AGE_i \text{cov}(\hat{\beta}, \hat{\beta}_3) + 4IMP_i \cdot AGE_i \text{cov}(\hat{\beta}, \hat{\beta}_4) \] (3)

With formula (2) and (3), we substitute the relevant values of Post-surprise Improvisation and Age at the mean, a standard deviation below, and a standard deviation above the mean to calculate regression coefficient estimates (Aiken & West, 1991; Brambor, Clark, & Golder, 2005; Jaccard et al., 1990).

Marginal effect of firm age on outcome. The change in the dependent variable Surprise Perceived outcome for a marginal change of Age for firm \( i \) is:

\[ \frac{\partial y_i}{\partial AGE_i} = \beta_3 + \beta_4 IMP_i \] (4)

Standard errors of the marginal change can be derived with the following formula:

\[ \hat{\sigma}^2 \frac{\partial y_i}{\partial AGE_i} = \text{var}(\hat{\beta}_3) + IMP_i^2 \text{var}(\hat{\beta}_4) + 2IMP_i \text{cov}(\hat{\beta}_3, \hat{\beta}_4) \] (5)

With formula (4) and (5), we substitute the relevant values of Post-surprise Improvisation at the mean, a standard deviation below, and a standard deviation above the mean to calculate regression coefficient estimates (Aiken & West, 1991; Brambor, Clark, & Golder, 2005; Jaccard et al., 1990). The corresponding conditional analyses are presented as:
\[
\frac{\partial \text{OUTCOME}}{\partial \text{AGE}} \mid \text{IMP=low} = 0.038** (0.011) \\
\frac{\partial \text{OUTCOME}}{\partial \text{AGE}} \mid \text{IMP=mean} = 0.026** (0.009) \\
\frac{\partial \text{OUTCOME}}{\partial \text{AGE}} \mid \text{IMP=high} = -0.014 (0.011)
\]