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UNDERSTANDING RESPONSES TO SUPPLY CHAIN DISRUPTIONS: INSIGHTS FROM INFORMATION PROCESSING AND RESOURCE DEPENDENCE PERSPECTIVES

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Why, how, and under what conditions do firms respond to supply chain disruptions? These are important questions, given that firms around the world are increasingly exposed to disruptions that impede their supply chain relationships and associated operations. This study applies information processing and resource dependence perspectives to identify the repertoire of strategic responses to supply chain disruptions and to devise and test a model that explains the occurrence of the alternative responses. The findings suggest that these responses are shaped by the "stability motive" and by "interpretative postures," which evolve from past experiences.

Global competition has shaped complex and tightly coupled interfirm networks in which disruptions in the flows of materials, information, and funds have become the norm. A report from the World Economic Forum (2008), for example, treated the risk of supply chain disruptions as one of the four important emerging issues, alongside systemic financial risks, food security, and energy security. Any firm that collaborates with other firms in supply chains faces the risk that a disruption could undercut or even destroy its business (Chopra & Sodhi, 2004).

To date, scholars have focused on the causes of supply chain disruptions (Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007), supply chain vulnerability (Wagner & Bode, 2006), performance implications (Hendricks & Singhal, 2005), and the management of supply chain risks (Tang, 2006). Little attention, however, has been devoted to the strategic behavior that firms employ in the wake of supply chain disruptions. Although anecdotal evidence suggests that firms may respond to these events in different ways (Sheffi, 2005), understanding of the mechanisms that shape these responses is very limited. Yet a firm's ability to effectively respond to adverse events and to accommodate latent problems or changes in its environment is critical to both its competitiveness and its long-term success (Aldrich, 1979; Child, 1972). Accordingly, the purpose of this study is to develop and test a proposed theoretical model that explains why, how, and under what conditions firms respond to supply chain disruptions.

As supply chain disruptions are interorganizational phenomena that involve a minimum of two firms engaged in a relationship, the unit of analysis in this study is a supply chain disruption affecting a dyadic relationship between a focal buying firm and one of its suppliers. The focus is on disruptions triggered in the network of suppliers or in the "inbound logistics network," such as supplier quality problems, delivery failures, and plant fires, that significantly threatened or impaired the normal course of business operations of the focal firm. To craft a holistic theory of organizational responses to these issues, we integrate organizational information processing (Galbraith, 1973; Tushman & Nadler, 1978) and resource dependence (Pfeffer & Salancik, 1978) perspectives. The proposed approach leverages some similarities between the two perspectives but also expands on key differences.

In terms of similarities, both theories suggest that firms strive for stability in their internal and exter-

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nal operations (Katz & Kahn, 1978; Thompson, 1967), which provides the motive for them to initiate responses to supply chain disruptions. To satisfy this stability motive, two generic response alternatives are available: buffering and bridging (Fennell & Alexander, 1987; Meznar & Nigh, 1995). *Buffering* actions are attempts to gain stability by establishing safeguards that protect a firm from disturbances that an exchange relationship confers, and *bridging* actions are attempts to manage uncertainty through engaging in "boundary-spanning" and "boundary-shifting" actions with an exchange partner.

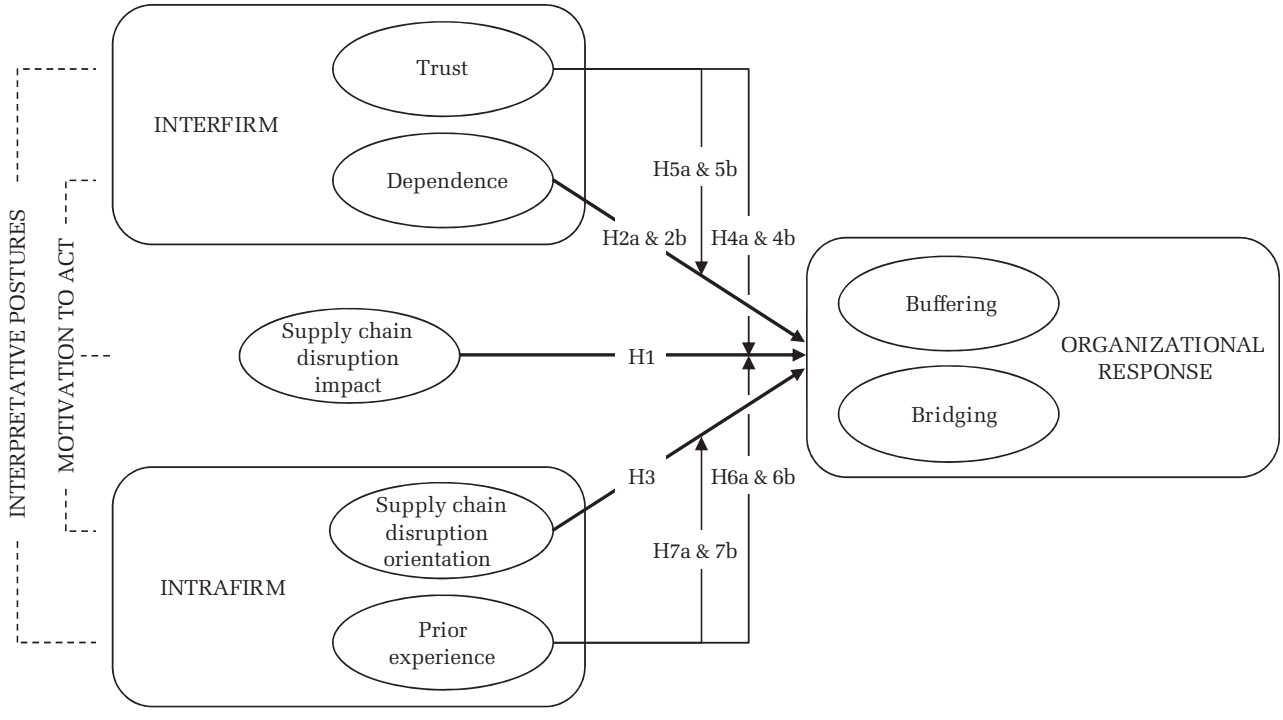
In terms of the differences, both theoretical lenses provide valid, yet incomplete insights into (1) the factors that arouse the stability motive and (2) how the resulting motivation to act is channeled into a specific kind of response. Resource dependence theory focuses on control, power, and vulnerability in a firm's external resource provisions, whereas the information processing perspective focuses on information and smoothly functioning internal processes. Integrating these different foci, our model suggests that the arousal of the stability motive and interpretative postures derived from past experiences are two intertwined mechanisms that jointly govern the disruption-response sequence. In detail, we investigate whether factors that create motivation to act—the impact of a supply chain disruption, the affected firm's dependence on its exchange partner, and the firm's supply chain disruption orientation—have a direct effect on both buffering and bridging. Moreover, we examine the possibility of moderation of these direct relationships by two important parameters of firms' interpretative postures: previously developed trust in the exchange partner involved in a disruption and prior experiences with supply chain disruptions. Our findings provide important theoretical contributions to the literature on supply chain disruptions and to the literature on organizational responses to adverse events.

THEORY AND HYPOTHESES

Organizational responses to adverse environmental events have been investigated in various settings and through many theoretical lenses (e.g., Chattopadhyay, Glick, & Huber, 2001; Ford & Baucus, 1987; Meyer, 1982). We reviewed and built on this prior work in the course of developing our hypotheses. However, with the exception of two notable qualitative studies (Grewal, Johnson, & Sarker, 2007; Primo, Dooley, & Rungtusanatham, 2007), the literature is limited in that it has not explicitly examined these issues across the boundaries of firms and at the dyad level.

Our theoretical model, presented in Figure 1,

FIGURE 1
A Model of Organizational Responses to Supply Chain Disruptions



links a firm's response processes with the substance of its response and addresses both internal (intrafirm) and external (interfirm) factors. The model is rooted in the notion that firms are interpretation systems that scan, interpret, and act upon events in their environments (Daft & Weick, 1984). Accordingly, for an adverse environmental event to precipitate an organizational response, a firm must develop a *motivation to act,* which means that the firm has to notice the event and interpret it as important with respect to its goals (Cowan, 1986). Furthermore, how this motivation is converted into action is influenced by firm-specific *interpretative postures,* which determine the particular kind of response that will occur (Gresov & Drazin, 1997; Isabella, 1990). Before elaborating on these two aspects and their interplay in the context of supply chain disruptions, we suggest it is essential to understand the corresponding motive and how it may be satisfied (i.e., the repertoire of responses). The following section describes how resource dependence and information processing perspectives complement each other in this respect.

Integrating Information Processing and Resource Dependence Perspectives

Motive. Owing to their mutual roots in the open systems paradigm, both the information processing and resource dependence perspectives rely on conceptions of firms as open systems that face environmental uncertainty but strive for an orderly and reliable pattern of resource flows (Katz & Kahn, 1978; Weick, 1969). Both perspectives suggest that reducing environmental uncertainty, also known as the stability motive (Oliver, 1991), is a core objective of a firm (Thompson, 1967). However, major differences between the two theories arise as to the underlying rationale that determines when environmental uncertainty is considered to be sufficiently problematic that it requires a response (Tan & Litschert, 1994).

The information processing perspective primarily focuses on firms' internal organization (Birkinshaw, Toulan, & Arnold, 2001), although it has been extended to cross-firm settings (Hult, Ketchen, & Slater, 2004). Environmental uncertainty is seen as a problem insofar as it renders a firm unable to plan and operate deterministically. Galbraith suggested that uncertainty refers to the "difference between the amount of information required to perform a task and the amount of information already possessed by the organization" (1973: 5). The more environmental uncertainty a firm faces, the more information it needs to gather and process to achieve a given level of performance. For the sake of effectiveness, firms strive to match their information processing needs with their information processing capabilities (Tushman & Nadler, 1978).

In contrast, resource dependence theory is primarily focused on a firm's relationships with its environment and exchange partners. The two major tenets of resource dependence theory are that (1) a firm's need for scarce external resources creates a dependence on its exchange partners and, hence, a potential source of adversity for the firm, and that (2) firms strive to minimize this dependence, which is tantamount to maximizing power (Pfeffer, 1981). Environmental uncertainty is only seen as problematic "when it involves an element of critical organizational interdependence" (Pfeffer & Salancik, 1978: 68). Thus, uncertainty is primarily associated with a lack of control and power over the environment but not with a lack of information, which implies that only uncertainties that arise from dependence relationships need to be managed.

In sum, although the stability motive is at core of both perspectives, each emphasizes distinct, but complementary, foci. The information processing perspective is more concerned with information and achieving smoothly functioning *internal* processes, and resource dependence theory is more concerned with control, power, and vulnerability in *external* resource provision (Kreiser & Marino, 2002). In both cases, it is critical not only that environmental uncertainty is present, but also that it is considered to be important—that is, either dependence on an external exchange partner is involved (Daft, Sormunen, & Parks, 1988) or information processing needs and information processing capacity are perceived as mismatching (Huber & Daft, 1987). As supply chain disruptions affect both domains, an integrated view that is informed by both perspectives is necessary to explain why firms respond to these events.

Response spectrum: Buffering and bridging. Researchers taking information processing and resource dependence perspectives acknowledge that firms have a choice about how to reduce environmental uncertainty to satisfy the stability motive (Gresov & Drazin, 1997; Oliver, 1991). According to resource dependence theory, responses can be differentiated on the basis of whether they are internal or external to a current exchange relationship (Carroll, 1993). From the information processing perspective, firms may either reduce the amount of information that needs to be processed or increase their capacity to process information (Galbraith, 1977). Both approaches can be linked to the same repertoire of coping strategies: buffering and bridg-

ing (Fennell & Alexander, 1987; Meznar & Nigh, 1995).

Buffering is external to a current relationship, as it is an effort to reduce a firm's exposure to the current exchange partner and to mitigate the detrimental consequences of disturbances that the relationship may confer (Carroll, 1993; Chattopadhyay et al., 2001). Viewed through the information processing lens, buffering reduces the information processing needs associated with a particular exchange relationship (Galbraith, 1977; Thompson, 1967). To this end, the firm can build up slack resources to act as "shock absorbers," such as larger inventories, flexible production processes, redundant suppliers, and product designs that are not dependent on a specific supplier (Tang, 2006).

Bridging is internal to a current relationship, as it is an effort to manage resource dependencies by enlarging a firm's influence over them (Pfeffer & Salancik, 1978). From an information processing perspective, a "bridge" forestalls uncertainty by facilitating access to reliable and timely information about looming supply chain disruptions and their consequences (Johnson, Sohi, & Grewal, 2004; Premkumar, Ramamurthy, & Saunders, 2005). A firm engaged in bridging may modify or manipulate an exchange relationship via more or less formal acts, ranging from the formation of relationships with influential individuals in the partner firm to vertical integration (Ulrich & Barney, 1984). In addition, bridging may be associated with investments in collaborative structures or initiatives such as joint risk management systems, or with scanning approaches such as monitoring or intensifying information exchanges (Flynn & Flynn, 1999; Pfeffer & Salancik, 1978).

In conclusion, neither buffering nor bridging is inherently "good" or "bad." Either of the two or a combination may be effective, depending on the specific context. Although they constitute independent approaches, buffering and bridging are not mutually exclusive. For example, a firm may decide to increase its safety stock (buffering), while simultaneously establishing better information exchange with an exchange partner (bridging).

Motivation to Act

A supply chain disruption may have direct and indirect negative effects on a firm's performance objectives. If the deviation from expected performance outcomes is noticed and exceptional (i.e., it exceeds some level defined as acceptable), it evokes nonroutine information processing and interpretation activities (Cyert & March, 1963; Kiesler & Sproull, 1982) in which the firm gathers information about this event to make sense of it (Daft & Weick, 1984). This information impinges on the stability motive and, depending on its interpretation of the disruption, the firm decides whether the event merits a response.

Disruption impact. The impact of a disruption represents a critical piece of information that a firm interprets to construct its beliefs about the stability of the affected exchange. As adverse events increase in magnitude, so do urgency about questioning existing behaviors, rules, strategies, or structures (Hedberg, 1981; Zakay, Ellis, & Shevalsky, 2004) and motivation to restore stability (Ford, 1985). For instance, in the wake of a serious supply chain disruption, the telecommunications equipment provider Ericsson reassessed and radically changed its supply chain risk management processes (Norrman & Jansson, 2004; Sheffi, 2005). The impact of a disruption reveals a firm's apparent lack of control over an exchange relationship and its inability to safeguard against the inherent uncertainty. Not surprisingly, a firm's dissatisfaction with a supplier increases with the impact of a disruption (Primo et al., 2007), with greater loss causing greater arousal of the firm's stability motive and thus, greater motivation to act (Meyer, 1982). However, when one is considering only the impact of the disruption, the motivation to act should be unbiased with regard to buffering or bridging; a firm has no reason to prefer either strategy over the other. Therefore,

> *Hypothesis 1. The greater the impact of a supply chain disruption on a firm, the greater its pursuit of* buffering *and* bridging. *The two relationships are not significantly different in strength.*

In addition, the resource dependence and information processing perspectives suggest two specific factors that affect a firm's motivation to act in the wake of a supply chain disruption.

Dependence on exchange partner. From a resource dependence perspective, a supply chain disruption requires a response when it entails a dependence relationship (Pfeffer & Salancik, 1978). Dependence on an exchange partner implies that a firm needs to maintain the relationship with the partner to achieve its desired goals (Emerson, 1962). As the degree of dependence increases, so does the likelihood that the firm considers the occurrence of a disruption to be important and reflective of its lack of control (Buchanan, 1992; Daft et al., 1988), thereby arousing the stability motive (Green & Welsh, 1988). Thus, from resource dependence theory, it follows that the higher the degree of dependence, the higher the firm's motivation to

restore stability and to pursue buffering and bridging (Kotter, 1979; Milliken, 1990).

Concurrently, dependence on an exchange partner structurally constrains a firm's options, as the costs of implementing buffers become prohibitively high at very high levels of dependence (Dwyer, Schurr, & Oh, 1987; Pfeffer & Salancik, 1978). In fact, at high levels of dependence, a firm is held hostage to such a relationship (Heide & John, 1988). For example, to safeguard production of one of its convertibles, the carmaker BMW was forced to financially support an almost bankrupt supplier of complex sun roofs (an act of bridging). Buffering was not an option here because the items were highly customized (Milne, 2009). This evidence suggests that buffering will be employed to a greater degree at moderate levels of dependence, where a firm is motivated to act, but not in a completely reliant relationship. At low and high levels of dependence, however, it will be employed to a relatively lower degree (i.e., an inverted U-shaped relationship will emerge). Formally,

Hypothesis 2a. A firm's pursuit of buffering *is greater at moderate levels of dependence on an exchange partner than at low and high levels of dependence.*

The option of pursuing bridging is not delimited by the level of dependence. On the contrary, given the problem of managing to both stabilize resource provision and maintain a particular exchange relationship, a firm's response will focus on strengthening the relationship (Beckman, Haunschild, & Phillips, 2004). When no alternatives for uncertainty reduction are available, firms form alliances (Young-Ybarra & Wiersema, 1999) or attempt to improve collaboration and information exchange with their partners (Skinner, Gassenheimer, & Kelley, 1992). Thus,

Hypothesis 2b. The higher a firm's dependence on an exchange partner, the greater its pursuit of bridging.

Supply chain disruption orientation. From an information processing perspective, a supply chain disruption requires a response when it indicates a mismatch between a firm's information processing capabilities and its information processing needs. However, as such a mismatch is difficult to infer from a single event, the firm's orientation toward supply chain disruptions drives its motivation to act. In fact, firms may differ in the level of stability they require from their operations and in their level of concern with supply chain disruptions. This leads to differential levels of information processing needs. We can conceptualize a continuum with firms that are more active in using information to try to influence the environment at one end, and more passive and limited information processors at the other. Daft and Weick (1984) labeled firms that are vigilant toward their environment, behave proactively and assertively, and strive to learn from their experiences as *active firms.* In contrast, *passive firms* accept the environment as given, interpret it within narrow limits, are reluctant to engage in active information searches, and are slow to respond to environmental events.

Building on these arguments and drawing on the supply chain risk management literature (e.g., Autry & Bobbitt, 2008; Christopher & Peck, 2004; Sheffi, 2005), as well as research related to a firm's orientations, such as its market (Narver & Slater, 1990) or its entrepreneurial orientation (Lumpkin & Dess, 1996), we define *supply chain disruption orientation* as a firm's general awareness and consciousness of, concerns about, seriousness toward, and recognition of opportunity to learn from supply chain disruptions. The stronger the firm's supply chain disruption orientation, the more importance it attaches to the issue of supply chain disruptions and the more pronounced its need for stability is. This argument suggests that a strong supply chain disruption orientation leads to a stronger motivation to act in the wake of a disruption. However, when only considering its supply chain disruption orientation, the firm lacks a reason to prefer either buffering or bridging. Thus,

Hypothesis 3. The higher a firm's supply chain disruption orientation, the greater its pursuit of buffering *and* bridging. *The two relationships are not significantly different in strength.*

Interpretative Postures

Thus far, the discussion has attended to the stability motive and how its arousal leads to the pursuit of buffering and bridging. Observing the presence of this mechanism, however, reveals nothing about the *specific* responses firms select, although firms may have preferences for buffering or bridging. According to the information processing perspective, firms may differ significantly in their cognition and "modes of interpretation" (Daft & Weick, 1984: 289), or the manner in which they process, manipulate, and ultimately utilize information from their environment. Hence, the developed motivation to act is not necessarily connected with the actual response in a simple way, but conditioned by firm-specific interpretative postures (Ford & Baucus, 1987; Meyer, 1982).

Interpretative postures evolve over time and are the product of past experiences (Thomas & Mc-

Daniel, 1990; Weick, 1969). Every firm has learned preferences for the parameters that it uses to determine its response in light of the environmental uncertainty it faces (Huber, 1991). In this vein, and in the supply chain context, Hult, Ketchen, and Slater defined "achieved memory" as "the amount of knowledge, experience, and familiarity with the supply chain process" (2004: 243). This definition addresses both intrafirm and interfirm aspects, suggesting that to understand a firm's interpretation of a supply chain disruption, not only is it necessary to consider the firm's experience with such disruptions, but also its experience with the involved exchange partner. The latter is reflected in the amount of trust in the partner (Anderson & Narus, 1990). Therefore, prior experiences with supply chain disruptions and trust in the exchange partner should serve as important parameters for firms' interpretative postures and provide conditions under which the firm's motivation to act develops.

Trust in the exchange partner. Trust is considered to be central to explaining a firm's interpretation of and behavior toward its exchange relationships (Morgan & Hunt, 1994). For example, interfirm trust may affect a firm's "sensemaking" (Weick, 1995) in the wake of a marketing crisis (Grewal et al., 2007). Trust in an exchange partner can be described as an expectation or a belief that the exchange partner will honor its commitments (is credible) and has good intentions (is benevolent) (Doney & Cannon, 1997; Ganesan, 1994).

Low prior trust implies that a firm has a desire to protect itself from the effects of the exchange partner's conduct. Under these conditions, a supply chain disruption confirms the firm's expectations about the relationship—that the partner is not trustworthy (Deutsch, 1973). When facing an apparent loss, decision makers tend to focus on information that confirms prior beliefs ("I knew it all along!"). As Gooding and Kinicki argued, "If an event conforms to one's beliefs and expectations, there is no reason to seek causal explanation for the event" (1995: 5). Consequently, the positive relationship between disruption impact and the pursuit of buffering and bridging should diminish, because interpretation of the event does not take place. Instead, the firm's desire to insulate itself principally governs its response to the disruption, leading to high levels of buffering and low levels of bridging.

In contrast, when prior trust in an exchange partner is high, the occurrence of a supply chain disruption contradicts a firm's beliefs about the exchange relationship (Dirks, Lewicki, & Zaheer, 2009). The event is inconsistent with the firm's experience-based confidence in the exchange partner's ability to act reliably and in the firm's best interests (Morgan & Hunt, 1994). Failed expectations and surprise have been reported to promote information search processes (Cyert & March, 1963; Ellis & Davidi, 2005). There may still be confidence in the exchange partner's ability to fulfill its obligations and its intent to not exploit vulnerabilities (Mayer, Davis, & Schoorman, 1995), but the contradiction of the focal firm's initial belief motivates the firm to closely investigate the disruption and its causes (Barr, 1998). As a result, the impact of the disruption will likely receive more attention and gain greater influence in response formation. In particular, as the impact of the supply chain disruption increases, the firm is increasingly motivated to employ the trust verification strategies of bridging (e.g., monitoring the partner) and, to a lesser extent, of buffering (e.g., screening the market for potential alternative suppliers to make comparative evaluations) (Heide, Wathne, & Rokkan, 2007). Hence, under conditions of high prior trust, a firm's response (in terms of both buffering and bridging) should be sensitive to the disruption impact. Merging the predictions for low-trust and high-trust cases,

> *Hypothesis 4a. The positive relationship between the impact of a supply chain disruption and the pursuit of* buffering *is weaker when prior trust in the involved exchange partner is low than when it is high.*

> *Hypothesis 4b. The positive relationship between the impact of a supply chain disruption and the pursuit of* bridging *is weaker when prior trust in the involved exchange partner is low than when it is high.*

Prior trust also affects the relationship between dependence and a firm's response (Andaleeb, 1995). As delineated above, given low prior trust, the confirmed belief that an exchange partner is not credible and benevolent governs the firm's motivation to act, which creates a priori preferences for high levels of buffering and low levels of bridging. However, as resource dependence theory suggests, these preferences can only be put into effect if dependence on the exchange partner is low. With increasing dependence, buffering becomes more difficult and bridging more attractive, so that the focal firm is driven into low levels of buffering and high levels of bridging. In effect, high and low levels of dependence lead to diametrically opposed response patterns, implying that a firm's response depends strongly on its level of dependence on the exchange partner. Consequently, in the low trust case, buffering peaks at lower levels of dependence and decreases faster at moderate and higher levels

of dependence; that is, the inverted U-shaped relationship is steeper and peaks at a lower level of dependence.

In contrast, at high levels of prior trust, the occurrence of the disruption triggers information search processes that generate a motivation to employ trust verification strategies of bridging and, to a lesser extent, of buffering. With increasing dependence, however, the "trust-but-verify" intentions become secondary and are replaced by the dominant need to pursue bridging. These arguments indicate that the relationship between dependence and the pursuit of bridging is weaker under conditions of high trust. With respect to buffering, its increase at lower levels of dependence and decrease at higher levels of dependence is slower. The pursuit of buffering with respect to dependence shifts from low to moderate (e.g., trust verification), and then back to low (i.e., the inverted U-shaped relationship is flatter and peaks at higher levels of dependence). Merging predictions for the low and high trust cases,

Hypothesis 5a. A firm's pursuit of buffering *peaks at lower levels of dependence when trust is low than when it is high, and the rate of increase (before the peak) and the rate of decrease (after the peak) are greater when trust is low than it is when trust is high.*

Hypothesis 5b. The positive relationship between dependence on an exchange partner and the pursuit of bridging *is stronger when prior trust in the exchange partner is low than it is when trust is high.*

Prior experience. As interpretative processes are often based on the most recent set of experiences (Kiesler & Sproull, 1982), *prior experience* is conceptualized as the number of supply chain disruptions a focal firm has faced during the past 12 months (before a specific supply chain disruption) and in the same product line as the specific supply chain disruption.

The occurrence of a supply chain disruption may indicate to a firm that its information processing capabilities and information processing needs are mismatched, but without relevant prior experiences, the firm has difficulty determining the form and the strength of a response that restores fit and, consequently, stability (Sinkula, 1994). A firm that has encountered many supply chain disruptions has more complete information regarding the options available to restore stability (Galaskiewicz, 1985) and more confidence about using the full range of the response menu, because it has a better understanding of the response-outcome relationship (Daft & Weick, 1984; Fiol & Lyles, 1985). Also, an experienced firm has likely developed dedicated rules and routines for dealing with supply chain disruptions (Green & Welsh, 1988). If a firm is familiar with interpreting and reacting to supply chain disruptions, its responses will be more effective in addressing a particular disruption. A high level of prior experience should therefore amplify the positive relationship between disruption impact and buffering and bridging.

In contrast, firms that have been exposed to few supply chain disruptions lack relevant knowledge and are unfamiliar with interpreting these events. Hence, these firms face difficulties in determining adequate responses. A lack of knowledge leads to the application of simple rules of thumb (heuristics) that do not accurately match the actual impact of a disruption (Cyert & March, 1963). This summation suggests that firms with little prior experience likely overreact to small disruptions and underreact to large ones. Consequently, the positive relationship between disruption impact and the pursuit of buffering and bridging weakens. Formally,

Hypothesis 6a. The positive relationship between the impact of a supply chain disruption and a firm's pursuit of buffering *is weaker when the firm's prior experience is low than it is when prior experience is high.*

Hypothesis 6b. The positive relationship between the impact of a supply chain disruption and a firm's pursuit of bridging *is weaker when the firm's prior experience is low than it is when prior experience is high.*

In addition, from our conceptualization of supply chain disruption orientation, it follows that active firms exploit prior experiences differently than passive firms. During the response-forming process, an active firm likely seeks to gain a better understanding of the supply chain disruption with a focus on identifying its underlying root causes. The buffering strategy is inappropriate to serve this purpose, as its direction is external to the current exchange relationship. To gather additional information on the specific disruption, the firm needs to delve into the exchange relationship involved by bridging. In contrast, as passive firms accept the environment as given, they are less motivated to take additional steps that require time and effort to get at the root cause of the disruption to understand the sources of uncertainty in the relationship (Daft & Weick, 1984). A passive firm interprets such an event within traditional boundaries and attempts to associate the unfamiliar experience with one that it

knows and understands. Thus, minimal prior experience intensifies the positive relationship between supply chain disruption orientation and the pursuit of bridging and weakens the positive relationship with the pursuit of buffering.

If firms have experienced many supply chain disruptions recently, the gains from a bridging strategy (associated with establishing better knowledge about supply chain disruptions) become incremental. Moreover, handling a large number of parallel bridging initiatives requires considerable information processing capabilities, in the form of purchasing managers who monitor a large set of suppliers, coordinate several contingency plans, or engage in frequent information exchange with suppliers. Extensive use of bridging may overload a firm's purchasing and supply chain management functions and impair the quality of these functions' core tasks (Galbraith, 1973). Therefore, when the number of supply chain disruptions becomes great, firms with a high supply chain disruption orientation employ a more defensive approach to restore stability and protect their operations (Galbraith, 1977; Thompson, 1967). They likely select the buffering option as it reduces information processing needs and mitigates the consequences of future disruptions. Consequently, high prior experience should amplify the positive relationship between a firm's supply chain disruption orientation and the pursuit of buffering and weaken the positive relationship with the pursuit of bridging. Merging the predictions for the low experience and high experience cases,

Hypothesis 7a. The positive relationship between a firm's supply chain disruption orientation and its pursuit of buffering *is weaker when the firm's prior experience is low than it is when prior experience is high.*

Hypothesis 7b. The positive relationship between a firm's supply chain disruption orientation and its pursuit of bridging *is stronger when the firm's prior experience is low than it is when prior experience is high.*

METHODS

Data and Procedure

To test the hypotheses on a broad empirical basis, we conducted a survey of 3,945 firms in Germany, Austria, and Switzerland and subsequently enhanced this data set with secondary data. Each case in our sample refers to a specific supply chain disruption and a dyadic exchange relationship in the manufacturing sector.

Primary data. Primary data were collected between June and September 2007 by means of a self-administered internet-based survey. We obtained contact addresses from a commercial business data provider, selecting each respondent on the basis of job function, firm size (the criterion was more than 50 employees), and industry sector (defined by SIC code). The survey targeted senior managers in purchasing or supply chain management departments who were likely to have an overarching, boundary-spanning view of their firms' supply networks and supplier activities.

Considerable attention was paid to the design of the survey instrument, in particular the ease of use, burden on respondents, and maintaining their interest until the survey was completed. Furthermore, our methodology incorporated several procedural remedies for controlling common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Accordingly, the survey instrument provided only general information about the study's objectives, but no clues about the actual relationships under investigation. We offered anonymity (of the respondent) and confidentiality to reduce the chances of responses that were socially desirable, or consistent with how respondents believe researchers want them to respond. In addition, following Doty and Glick (1998), in the design of the survey instrument we emphasized the concreteness of constructs by anchoring responses in a particular situation. Respondents were asked to base their answers on a specific supply chain disruption entailing a significant performance deviation that had occurred during the 12 months preceding data collection and involved a specific supplier that was not necessarily entirely responsible for the disruption. Reported supply chain disruptions were triggered by issues such as labor strikes, quality problems, plant fires, cargo losses, changes in product designs, and bankruptcies.

In exchange for participation, respondents were offered a summary of the results as well as a practitioner-oriented purchasing book written by one of the authors. After three follow-up e-mails and reminder phone calls, we received 462 responses. Seven questionnaires were discarded from this initial sample because the respondents had limited knowledge about the unit of analysis; these exclusions left 455 usable questionnaires and an effective response rate of 11.5 percent. Recent surveys of supply chain management professionals have reported similar response rates (e.g., Gibson, Mentzer, & Cook, 2005). This sample size allowed us to detect ($p < .05$) relatively small population effects (for population correlations, as small as $|\rho| = .13$) with a chance of 80 percent (Cohen, 1988).

The data collection yielded a heterogeneous sample covering a broad range of manufacturing industry sectors and firm sizes and revealed no indication of systematic bias. Table 1 provides a detailed industry breakdown of the sample. Respondents' firms' annual sales volume in 2006 ranged from US$1 million up to US$114.84 billion (mean = US$1,154 million, s.d. = $7,651 million), and firms' number of employees ranged from fewer than 100 to 445,000 (mean = 2,978, s.d. = 23,822). Most of the respondents were senior managers in purchasing. They had been in their current positions for an average of 6.71 years (s.d. = 5.81) and with their firms for 11.17 years (s.d. = 9.21). Their work experience involved purchasing, logistics, or supply chain management for an average of 14.30 years (s.d. = 8.44). In addition, these individuals indicated a high degree of knowledge about the reported supply chain disruption (mean = 4.00, s.d. = 0.71) and exchange relationship (mean = 3.68, s.d. = 0.88), using ratings ranging from 1, "not knowledgeable at all," to 5, "extremely knowledgeable."

Limits on the ability of the respondents to recall the disruption (recency effect) was a potential threat to the validity of the findings. Therefore, the survey instrument asked for the exact month of the supply chain disruption. Using these dates, we split the data set into three equally sized groups (early, mid, and late) and performed a multivariate analysis of variance (MANOVA) using all items to inspect the mean differences among these groups. No significant differences were found at the multivariate level (Wilks's $\lambda = 0.84$, $p = .15$), and only three of the 33 rating scale items revealed statistically significant differences at the univariate level ($p < .05$).

TABLE 1
Industry Breakdown

Industry Sector	Frequency	Percentage
Industrial machinery, machine tools	68	14.9
Electronics, optics, medical devices	63	13.8
Automotive	59	13.0
Chemicals, plastics, rubber	48	10.5
Metals, metal working	48	10.5
Pharmaceuticals, health care	28	6.2
Paper and packaging	26	5.7
Consumer goods	24	5.3
Engineering, construction	23	5.1
Textiles and clothing	16	3.5
Food, beverages	14	3.1
Aerospace, defense	7	1.5
Telecommunications	6	1.3
Other	25	5.5

Two approaches were used to assess whether nonresponse bias was present in the sample. We found no statistically significant differences ($p < .05$) among the responses from early (initial invitation) versus late respondents (first, second, and third reminder) for all items (Armstrong & Overton, 1977). In addition, we compared the obtained sample with 100 randomly selected nonresponding firms drawn from the initial sample ($N = 3,945$) on annual sales, employees, and firm age (in 2006). No statistically significant differences between the two groups were found ($p < .05$).

Secondary data. For all cases in the survey data set, we gathered objective secondary data for the variables firm age and firm size from two commercial databases.[1] In both cases, the variables were highly correlated with their counterparts in the primary data set ($r > .80$), suggesting that the primary data were of good quality.

Measures

To measure *dependence* on and *trust* in the exchange partner involved in each focal incident, we used established multi-item scales. For the remaining constructs, new multi-item measures were developed. The *disruption impact* was conceptualized in a formative way, whereas all other constructs were conceived of as reflective. We followed multistage scale development techniques for the reflective (DeVellis, 2003) and formative scales (Diamantopoulos & Winklhofer, 2001; Petter, Straub, & Rai, 2007). This process included several preliminary qualitative interviews with purchasing managers, an extensive review of the extant academic and practitioner literature, in-person pretesting, and a pretest study. Six items from the initial item pool were deleted during the measurement purification process. Appendix A presents the items for each construct. With regard to timing, the measures of trust, dependence, and prior experience refer specifically to the situation *before* the supply chain disruption. All other measures refer to the situation *after* the event.

Dependent variables. We measured *buffering* and *bridging* in terms of activities that a focal firm pursued or intended to pursue in response to the supply chain disruption of interest. These activities were derived from the extant supply chain risk management literature and from the preliminary interviews. *Buffering* was measured with three items reflecting the activities of insulating the firm

[1] Bloomberg Professional Service (Bloomberg, New York, USA) and AMADEUS (BvDEP, Frankfurt, Germany).

from its task environment. *Bridging* was measured with five items reflecting collaborative supply chain initiatives, improved information exchange, and stricter monitoring of the focal exchange partner.

Independent variables. Supply chain *disruption impact* captures the extent to which a disruption had (direct or indirect) negative effects on a focal firm. As a supply chain disruption can have a variety of *possibly uncorrelated* negative outcomes, such as loss of revenues, poor asset utilization, inventory management problems (write-offs, stockouts), and damage to reputation and credibility, a formative model is appropriate (Diamantopoulos & Winklhofer, 2001). To entirely capture this multifaceted nature, we used a six-item scale that relates to resource provision (procurement costs), production process (efficiency of operations, quality of final products), customers (responsiveness, delivery reliability), and financial performance (return on sales).

Dependence on the exchange partner was measured by a scale proposed by Jap and Ganesan (2000). This four-item scale assesses a firm's inability to replace a given exchange partner, to find an alternative partner, and to achieve its goals in the event that the relationship is terminated.

We developed a new five-item scale for the firm-level construct *supply chain disruption orientation* by leveraging items from a scale measuring organizational error management culture (van Dyck, Frese, Baer, & Sonnentag, 2005) and a scale measuring climate for initiative (Baer & Frese, 2003). The adopted items along with newly developed items reflect the zeal to learn from supply chain disruptions and a state of permanent alertness and dynamic awareness. To reduce proneness to social desirability bias, we formulated items to focus on behaviors rather than on beliefs.

The measure of trust in the exchange partner involved in a focal incident is based on a definition of trust as a belief, sentiment, or expectation that the exchange partner is credible and benevolent (Ganesan, 1994). In congruence with prior research, we treated trust as a second-order factor along these two first-order dimensions and adopted a scale developed by Doney and Cannon (1997). *Credibility* comprises three items that assess the likelihood that the exchange partner will keep its promises and honor its commitments. *Benevolence* comprises three items that assess the degree to which the exchange partner engages in actions that support the business activities of the focal firm.

Prior experience refers to the number of supply chain disruptions that the focal firm incurred during the prior year related to the product line that was most involved in the specific supply chain disruption. Following Rossiter (2002), we used a single item to measure this variable, which was logarithmically transformed prior to subsequent model estimation.

Control variables. We included firm age, firm size, relationship length, and competitive intensity as control variables in the analyses. *Firm age*, measured as the difference between the founding year and the current year, and *firm size,* measured as the number of employees in a focal firm, may affect organizational actions and inertia (e.g., Chattopadhyay et al., 2001). *Relationship length,* measured as the period of time (in years) that the focal firm had worked with the specific exchange partner, may influence decisions that concern the modification of a relationship (Dwyer et al., 1987). Firm age, firm size, and relationship length were logarithmically transformed. Finally, *competitive intensity,* the extent to which the firm perceived its competition to be intense, was included, because it might affect the interpretation of adverse environmental events (Barr, 1998). We measured this construct with a four-item scale, adopted from Jaworski and Kohli (1993), asking respondents to elaborate on the intensity of rivalry among firms in their industry.

Measure Assessment

Prior to measure assessment, we applied the expectation-maximization algorithm to impute the few missing values (less than 2 percent of the total data points) (Little & Rubin, 2002).

Reflective measurement. We assessed the reflective scales' psychometric properties by means of a covariance-based confirmatory factor analysis (CFA). All reflective independent and dependent latent variables were included in a single multifactorial CFA model. Given that we found some indications of the presence of multivariate nonnormality, we applied maximum-likelihood estimation with robust standard errors using the MLR estimator in Mplus 6.[2] The measurement model revealed an acceptable fit to the data (Hair, Black, Babin, Anderson, & Tatham, 2006) ($\chi^2/df = 2.28$ [$\chi^2_{307} = 699.99$, $p < .001$], CFI = .92, TLI = .91, SRMR = .06, RMSEA = .05 [90% CI = (.05, .06)]).[3] Details of the measurement model appear in Appendix A,

[2] As used in our analyses, chi-square incorporates a scaling correction based on the degree of multivariate nonnormality (Muthén & Muthén, 2010).

[3] "CFI" is the comparative fit index; "TLI," the Tucker-Lewis index (also the nonnormed fit index [NNFI]); "SRMR," the standardized root-mean-square residual;

TABLE 2
Descriptive Statistics, Correlations, and Average Variances Extracted[a, b]

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12
1. Disruption impact	17.76	4.77	–	**.05**	**.01**	**.03**	**.03**	**.01**	**.06**	**.04**	**.00**	**.00**	**.02**	**.01**
2. Dependence	3.72	1.01	.22**	*.84*	**.03**	**.01**	**.01**	**.00**	**.00**	**.10**	**.01**	**.01**	**.07**	**.00**
3. Supply chain disruption orientation	3.94	0.62	.07	.19**	*.56*	**.01**	**.01**	**.02**	**.07**	**.15**	**.01**	**.00**	**.01**	**.03**
4. Credibility	3.67	0.76	−.18**	.08	.11*	*.84*	**.57**	**.01**	**.07**	**.04**	**.00**	**.01**	**.08**	**.00**
5. Benevolence	3.44	0.77	−.17**	.08	.10*	.75**	*.72*	**.00**	**.07**	**.04**	**.00**	**.01**	**.07**	**.00**
6. Prior experience[c]	1.67	1.32	.10*	−.01	.14**	−.07	−.07		**.00**	**.01**	**.01**	**.02**	**.00**	**.00**
7. Buffering	3.21	0.91	.25**	−.04	.27**	−.27**	−.26**	−.06	*.62*	**.00**	**.01**	**.00**	**.01**	**.00**
8. Bridging	3.07	0.94	.19**	.31**	.38**	.21**	.20**	.09	−.04	*.80*	**.00**	**.01**	**.00**	**.01**
9. Firm age[c]	3.70	0.95	−.02	.09	−.08	−.02	−.01	−.08	.09	−.07		**.03**	**.07**	**.00**
10. Firm size[c]	6.03	1.60	−.06	.08	.04	−.11*	−.10*	.13**	.04	.10*	.18**		**.00**	**.00**
11. Relationship length[c]	2.03	0.92	−.13**	.26**	.09	.27**	.26**	.02	−.11*	.06	.26**	.06		**.00**
12. Competitive intensity	3.30	0.75	.08	.05	.18**	.07	.07	.03	−.01	.07	.04	.02	.03	*.56*

[a] Values on the diagonal in italic are average variances extracted (where appropriate); squared correlations (shared variance) are in bold and above the diagonal; Pearson correlation coefficients are below the diagonal.
[b] All $|r| > .09$ are significant at $p < .05$, and all $|r| > .12$ are significant at $p < .01$. Two-tailed tests.
[c] Transformed using the natural logarithm.

and the interconstruct correlations and average variances extracted appear in Table 2.

The CFA results indicated acceptable psychometric properties for all constructs, illustrating that the reflective items captured the respective underlying latent variables well and implying a satisfactory level of convergent validity and internal consistency. Without exception, each item loaded on its hypothesized factor with a large and significant loading (all λ significant at $p < .001$). Composite reliabilities and average variances extracted of all constructs exceeded the common cutoff values of .70 and .50 (Hair et al., 2006). We assessed discriminant validity using the criterion suggested by Fornell and Larcker (1981). As shown in Table 2, each construct extracted variance that is larger than the highest variance it shares with other constructs, so discriminant validity is supported. The results also support the higher-order structure of trust. In addition to the high and significant item loadings, the estimates of credibility ($\lambda = .77$, $p < .001$, $R^2 = .59$) and benevolence ($\lambda = .98$, $p < .001$, $R^2 = .96$) indicate convergent validity. Moreover, the correlation between the two first-order factors was significantly different from unity (1.0) ($\Delta\chi^2_1 = 154.86$, $p < .001$).

Having established the validity and reliability of the reflective scales, we used scale averages as latent variable scores for the final estimation. The results from our measurement assessment provided empirical justification for forming trust as the average of the average scores of credibility and benevolence (all unweighted).

Formative measurement. Before constructing the formative index for *disruption impact,* we conducted ordinary least squares (OLS) regression analyses to check for redundant items. Formative measurement raises the issue of indicator multicollinearity (Petter et al., 2007), but all variance inflation factors were low (<3), and the bivariate correlations between the indicators were within an acceptable range ($|r| < .80$) (Diamantopoulos & Siguaw, 2006). We created the formative index as the unweighted linear sum of the measurement items.

Common method variance. To detect whether common method variance posed a problem, we compared our CFA model with an extended model that included a single latent common method factor (CMF) that loaded equally on all reflective variables and was uncorrelated with all other latent variables (Podsakoff et al., 2003). The inclusion of the CMF only marginally improved model fit indexes ($\chi^2/df = 2.25$ [$\chi^2_{306} = 688.89$, $p < .001$], CFI = .92, TLI = .91, SRMR = .06, RMSEA = .05 [90% CI = (.05, .06)]). A chi-square-difference test ($\Delta\chi^2_1 = 3.74$, $p > .05$) also indicated that the CMF did not significantly improve model fit (Satorra & Bentler, 2001). To further scrutinize to what extent common method variance inflated correlations, we calculated the correlation coefficient between the latent variable correlations with and without the CMF and found a very high correlation ($r = .97$, $p < .001$). In summary, these results suggest that common method variance was unlikely to introduce substantial bias in our models.

"RMSEA," the root-mean square error of approximation; and "CI," the confidence interval.

ANALYSIS AND RESULTS

To test the developed hypotheses, we applied seemingly unrelated regression (SUR), a generalization of OLS estimation that is able to deal with multiequation systems giving rise to correlated error terms (Greene, 2008). All independent variables were mean-centered, and interaction terms were created by multiplying standardized variable scores (Cohen, Cohen, West, & Aiken, 2003). The following linear equation system was estimated in several hierarchical steps:[4]

$$\begin{aligned} BUF = {} & a^{\text{buffer}} + b_1^{\text{buffer}} SZE + b_2^{\text{buffer}} AGE + b_3^{\text{buffer}} REL \\ & + b_4^{\text{buffer}} CPI && \text{(Model 1)} \\ & + b_5^{\text{buffer}} IMP + b_6^{\text{buffer}} DEP + b_7^{\text{buffer}} DOR \\ & + b_{6'}^{\text{buffer}} DEP^2 && \text{(Model 2)} \\ & + b_8^{\text{buffer}} TRU + b_9^{\text{buffer}} EXP \\ & + b_{10}^{\text{buffer}} (TRU \times IMP) + b_{11}^{\text{buffer}} (TRU \times DEP) \\ & + b_{12}^{\text{buffer}} (EXP \times IMP) + b_{13}^{\text{buffer}} (EXP \\ & \qquad \times DOR) && \text{(Model 3)} \\ & + b_{11'}^{\text{buffer}} (TRU \times DEP^2) + \varepsilon^{\text{buffer}} \end{aligned}$$

$$\begin{aligned} BRI = {} & a^{\text{bridge}} + b_1^{\text{bridge}} SZE + b_2^{\text{bridge}} AGE + b_3^{\text{bridge}} RE \\ & + b_4^{\text{bridge}} CPI && \text{(Model 1)} \\ & + b_5^{\text{bridge}} IMP + b_6^{\text{bridge}} DEP + b_7^{\text{bridge}} DOR \\ & && \text{(Model 2)} \\ & + b_8^{\text{bridge}} TRU + b_9^{\text{bridge}} EXP \\ & + b_{10}^{\text{bridge}} (TRU \times IMP) + b_{11}^{\text{bridge}} (TRU \times DEP) \\ & + b_{12}^{\text{bridge}} (EXP \times IMP) + b_{13}^{\text{bridge}} (EXP \\ & \qquad \times DOR) + \varepsilon^{\text{bridge}} && \text{(Model 3)} \end{aligned}$$

Control variables were entered as a block in model 1, followed by the main effect variables in model 2 and the interaction terms in model 3 (simultaneous within blocks, stepwise across). In each step, we scrutinized influence diagnostics and verified that the assumptions underlying SUR estimation were met. The results appear in Table 3. With the exception of model 1 (buffering: $R^2 = .01$; bridging: $R^2 = .02$), all models were statistically significant ($p < .001$).

Model 2 captures the factors that were hypothesized to have a direct bearing on a firm's motivation to act and, consequently, the resulting response. The variance explained increased significantly (buffering: $\Delta R^2 = .15$; bridging: $\Delta R^2 = .17$; both $p < .001$), indicating medium effect sizes (buffering: $f^2 = .18$; bridging: $f^2 = .22$) (Cohen, 1988). We asked, first, whether more severe supply chain disruptions lead to a greater pursuit of both buffering and bridging (Hypothesis 1). The results reveal that disruption impact does positively affect buffering and bridging ($b_5^{\text{buffer}} = 0.04$, p $< .001$; $b_5^{\text{bridge}} = 0.03$, $p < .001$). But are the two response alternatives affected differently? Model 2 suggests that they are not. An *F*-test (based on the residual sum of squares) of the corresponding cross-equation restriction ($b_5^{\text{buffer}} = b_5^{\text{bridge}}$) indicated that the regression coefficients for disruption impact do not differ significantly across the two equations ($F_{1,\,893} = 1.49$, $p = .22$) (Greene, 2008). Together, these results lend empirical support for Hypothesis 1 and suggest that the disruption impact is an inadequate predictor for the directionality of organizational action in response to supply chain disruptions.

Next, the direct effects of dependence on the exchange partner are analyzed. Hypothesis 2a states that a firm makes greater use of buffering when dependence on the exchange partner involved in a disruption is moderate than when dependence is low or high. The results show a negative and significant coefficient for the linear term ($b_6^{\text{buffer}} = -0.14$, $p = .002$) and, in support of Hypothesis 2a, a negative and significant coefficient for the quadratic term ($b_6^{\text{buffer}} = -0.09$, $p = .01$). The inclusion of the latter explained a small but highly significant additional amount of variance in buffering ($\Delta R^2 = .01$, F of $\Delta R^2 = 6.87$, $p < .01$). These estimates indicate that the pursuit of buffering is lowest at both low and high levels of dependence and highest at intermediate levels (with the maximum of the inverse parabola being at a value of 3.14 for dependence). For bridging, Hypothesis 2b, which asserts a positive direct effect of dependence, received support ($b_6^{\text{bridge}} = 0.20$, $p < .001$). Overall, our prediction that dependence motivates the initiation of a response, but also constrains the pursuit of buffering, was supported.

Finally, the third factor hypothesized to directly affect a firm's response is supply chain disruption orientation (Hypothesis 3). The results suggest that supply chain disruption orientation has a positive effect both on buffering and on bridging ($b_7^{\text{buffer}} = 0.42$, $p < .001$; $b_7^{\text{bridge}} = 0.44$, $p < .001$). Again, we were interested in whether or not the responses are

[4] The variable identifiers are as follows: *BUF* = buffering, *BRI* = bridging, *SZE* = firm size, *AGE* = firm age, *REL* = relationship length, *CPI* = competitive intensity, *IMP* = disruption impact, *DEP* = dependence, *TRU* = trust, *DOR* = supply chain disruption orientation, *EXP* = prior experience.

TABLE 3
Results of Regression Analysis[a]

		Model 1: Control Variables						Model 2: Main Effects						Model 3: Moderator Effects					
		Buffering			Bridging			Buffering			Bridging			Buffering			Bridging		
Variable	Hypothesis	*β*	*b*		*β*	*b*		*β*	*b*		*β*	*b*		*β*	*b*		*β*	*b*	
Firm age		0.08	0.08	(0.05)	−0.08	−0.08	(0.05)	0.09	0.09*	(0.04)	−0.06	−0.06	(0.04)	0.09	0.09*	(0.04)	−0.04	−0.04	(0.04)
Firm size		0.02	0.01	(0.03)	0.10	0.06*	(0.03)	0.02	0.01	(0.03)	0.09	0.05*	(0.03)	0.00	0.00	(0.02)	0.11	0.06*	(0.02)
Relationship length		−0.10	−0.09	(0.05)	0.06	0.06	(0.05)	−0.08	−0.07	(0.05)	0.01	0.01	(0.05)	−0.02	−0.01	(0.05)	−0.05	−0.05	(0.05)
Competitive intensity		−0.00	−0.01	(0.06)	0.01	0.00	(0.06)	−0.05	−0.07	(0.05)	−0.04	−0.05	(0.05)	−0.06	−0.07	(0.05)	−0.05	−0.07	(0.05)
Disruption impact	1							0.22	0.04***	(0.01)	0.14	0.03**	(0.01)	0.20	0.04***	(0.01)	0.16	0.03***	(0.01)
Dependence	2b							−0.15	−0.14**	(0.05)	0.22	0.20***	(0.04)	−0.14	−0.13**	(0.04)	0.22	0.20***	(0.04)
Dependence squared	2a							−0.13	−0.09**	(0.04)				−0.14	−0.10**	(0.03)			
Supply chain disruption orientation	3							0.29	0.42***	(0.07)	0.29	0.44***	(0.07)	0.33	0.49***	(0.06)	0.24	0.37***	(0.07)
Trust														−0.22	−0.29***	(0.06)	0.20	0.27***	(0.06)
Prior experience														−0.11	−0.08**	(0.03)	0.05	0.04	(0.03)
Trust × disruption impact	4a, 4b													0.09	0.08*	(0.04)	0.09	0.09*	(0.04)
Trust × dependence	5a, 5b													−0.01	−0.01	(0.04)	−0.17	−0.15***	(0.04)
Prior experience × disruption impact	6a, 6b													0.09	0.08*	(0.04)	0.09	0.08*	(0.04)
Prior experience × supply chain disruption orientation	7a, 7b													0.17	0.15***	(0.04)	−0.14	−0.13***	(0.04)
Constant			3.21***	(0.04)		3.07***	(0.04)		3.30***	(0.05)		3.07***	(0.04)		3.30***	(0.05)		3.10***	(0.04)
R^2			.01			.02			.16			.19			.25			.28	
ΔR^2									.15			.17			.09			.09	
F			1.49			1.86			10.85***			15.24***			10.44***			12.97***	
F of ΔR^2									19.96***			32.56***			8.43***			8.53***	

[a] Seemingly unrelated regression was used (n = 455). "β" refers to standardized regression estimates, "b" refers to unstandardized regression estimates. Standard errors in parentheses.

* $p < .05$
** $p < .01$
*** $p < .001$
Two-tailed tests.

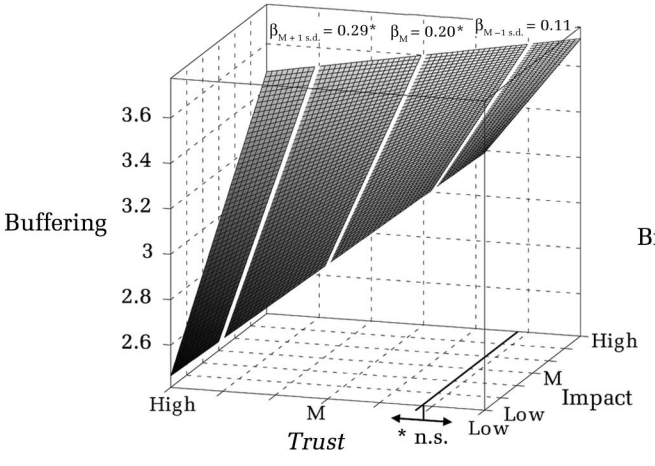
affected differently. An *F*-test of the corresponding equality restriction ($b_7^{buffer} = b_7^{bridge}$) indicated that the two regression coefficients do not differ significantly ($F_{1, 893} = 0.02$, $p = .89$). These results provide support for Hypothesis 3 and suggest that supply chain disruption orientation affects buffering and bridging with similar strength.

Model 3 introduces the moderator effects of trust and prior experience—that is, the eight interaction terms. The increase in model fit was significant ($\Delta R^2 = .09$, $p < .001$, for both buffering and bridging) and revealed medium effect sizes ($f^2 = .12$ for both buffering and bridging). Figure 2, a graph of the significant interaction effects, highlights the simple slopes for low (mean − 1 s.d.), moderate (mean), and high (mean + 1 s.d.) levels of the moderators. First, we address the moderator effects of trust. Hypotheses 4a and 4b state that the positive effect of disruption impact on buffering and bridging is stronger if prior trust in the partner involved in a focal disruption is high and weaker if prior trust in the partner is low. Both predictions received support, as the corresponding regression coefficients were significant and in the expected direction ($b_{10}^{buffer} = 0.08$, $p = .04$; $b_{10}^{bridge} = 0.09$, $p = .03$). Figures 2A and 2B show that the effect of disruption impact on buffering and bridging is approximately three times stronger when trust is high than when trust is low. The simple slopes indicate that a lack of trust even disables the direct effect of disruption impact. In this case, firms employ high levels of buffering and low levels of bridging—irrespective of the actual impact of the disruptions they have experienced.

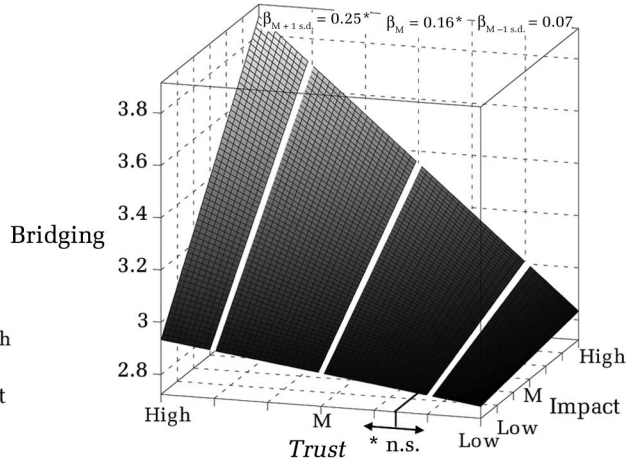
Mixed results were obtained for the prediction that a firm's pursuit of buffering and bridging is

FIGURE 2
Interaction Effects[a]

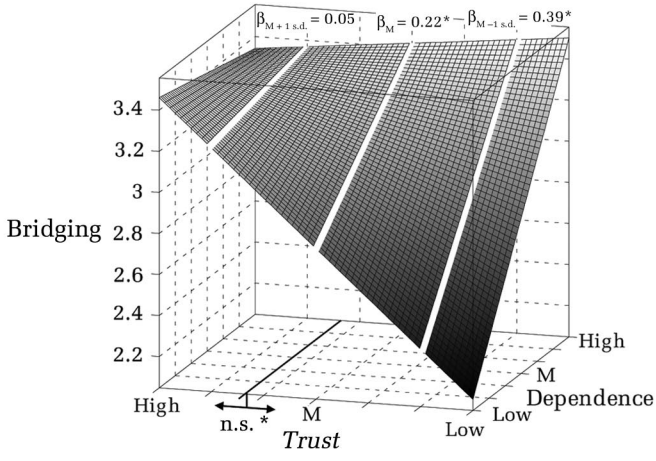
Trust and Disruption Impact
(2A) Hypothesis 4a



(2B) Hypothesis 4b



Trust and Dependence
(2C) Hypothesis 5b



more sensitive to dependence when trust is low than it is when trust is high. Hypothesis 5a states that trust moderates the inverted U-shaped relationship between dependence and the pursuit of buffering (as per Hypothesis 2a). No evidence was found for this moderation, either in the linear ($b_{11}^{\text{buffer}} = -0.01$, $p = .87$) or in the quadratic ($b_{11'}^{\text{buffer}} = -0.04$, $p = .29$) terms. Therefore, Hypothesis 5a was rejected. For bridging, however, the dependence-trust interaction term was negative, highly significant ($b_{11}^{\text{bridge}} = -0.15$, $p < .001$), and in the expected direction, thus supporting Hypothesis 5b. Figure 2C shows that the effect of dependence on bridging is eight times larger for low levels of trust than for high levels of trust. At very high levels of trust, the effect of dependence on bridging diminishes.

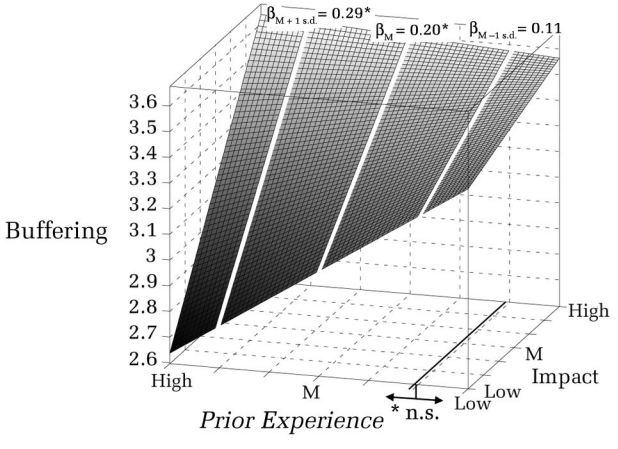
Second, we addressed the moderator effects of prior experience. As stated in Hypotheses 6a and 6b, a large number of recent experiences with supply chain disruptions is expected to lead a focal firm to be more sensitive to the impact of the disruption with respect to buffering and bridging. In support of both hypotheses, the regression coefficients for the experience-impact interaction terms were significant for both response approaches ($b_{12}^{\text{buffer}} = 0.08$, $p = .03$; $b_{12}^{\text{bridge}} = 0.08$, $p = .04$) and in the expected direction. Figures 2D and 2E reveal that the effect of disruption impact is approximately three times larger for high levels of experience than for low levels of experience.

Hypothesis 7a asserts that the positive effect of supply chain disruption orientation on a firm's pursuit of buffering is weaker when prior experi-

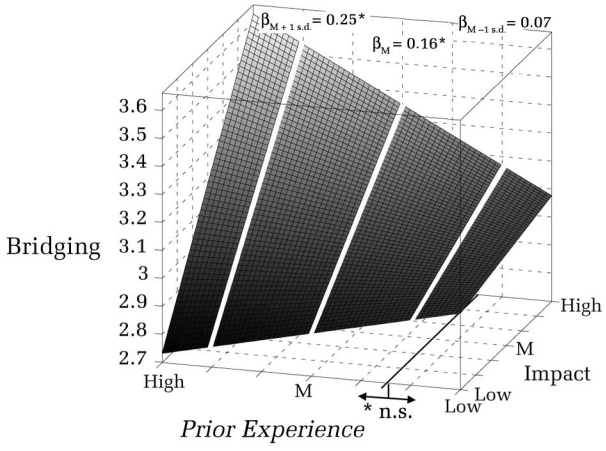
FIGURE 2
(Continued)

Prior Experience and Disruption Impact

(2D) Hypothesis 6a

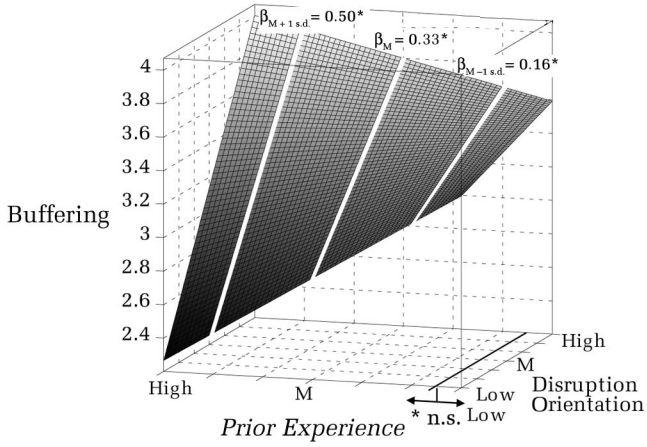


(2E) Hypothesis 6b

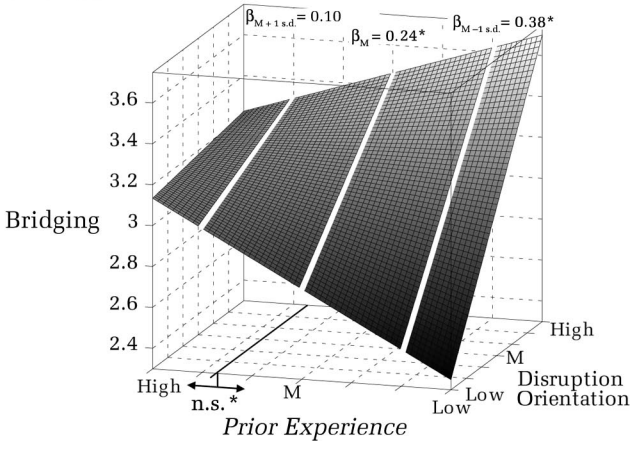


Prior Experience and Supply Chain Disruption Orientation

(2F) Hypothesis 7a



(2G) Hypothesis 7b



[a] Moderator variables are in italic. "M" is mean. Axis boundaries were set at the mean − 1.5 s.d. and mean + 1.5 s.d.; "n.s." refers to values of the moderator variables for which the interaction effects are not significantly different from zero ($p \geq .05$) (Bauer & Curran, 2005).

ence is low than it is when experience is high. In contrast, Hypothesis 7b posits that the positive effect of supply chain disruption orientation on pursuit of bridging is stronger when prior experience is low. Both predictions were supported by strong interaction effects ($b_{13}^{\text{buffer}} = 0.15$, $p < .001$; $b_{13}^{\text{bridge}} = -0.13$, $p < .001$). Figures 2F and 2G show that the positive effect of supply chain disruption orientation becomes operational only at high levels of prior experience for buffering (the slope is three times steeper at high levels of prior experience than at low levels), and at low levels of prior experience for bridging (the slope is almost four times steeper at low levels than at high levels).

DISCUSSION

Theoretical Implications

Several important scholarly implications can be deduced from the results. The core of our contribution lies in providing insights into the mechanisms that shape organizational responses to supply chain disruptions. We integrated information processing and resource dependence perspectives to capture both internal and external aspects of organizational responses to adverse environmental events. This approach is novel in the context of interfirm relationships and addresses a recent call to augment resource dependence theory with other theoretical lenses (Hillman, Withers, & Collins, 2009). Drawing on the two theories' common view that firms strive for stability, we elaborated that buffering and bridging are alternative response options for coping with supply chain disruptions. Beyond this common ground, however, each of these perspectives provides valid, yet partial, insights into the factors that predict the form and the strength of the organizational response. If the stability motive is the dominant force behind a firm's response, it is reasonable to expect that factors that stimulate this motive lead to stronger responses. Accordingly, the proposed integration framework suggests that resource dependence and information processing considerations drive a firm's motivation to respond to supply chain disruptions. Furthermore, in our framework we argue that the stability motive explains a firm's response to supply chain disruptions, but only in complex interplay with interpretative postures; that is, different past experiences lead to different responses.

The hypothesized main effects were supported. Subsequent to the occurrence of disruption to a firm's supply chain, motivation to act is produced by (1) the impact of the supply chain disruption, (2) the dependence on the exchange partner involved, and (3) the firm's supply chain disruption orientation. These factors affect the strength of the response yet by themselves are largely insufficient to explain how the motivation to act is channeled into buffering and bridging. The findings suggest that, with respect to disruption impact and supply chain disruption orientation, firms regard buffering and bridging as functionally equivalent and equally efficacious alternatives to support the goal of reducing uncertainty. The buffering option, however, is restricted by dependence on the exchange partner. Specifically, when dependence on the exchange partner increases, the pursuit of bridging activities also increases, but the pursuit of buffering follows an inverted U-shaped pattern. At high levels of dependence, the desire for stability creates commitment in terms of a firm's intention to continue the relationship and willingness to make short-term sacrifices (Dwyer et al., 1987). This may even hold true when the supply chain disruption leads to increased relational conflict, such as dissatisfaction, blame, or anger, triggered by the belief that the exchange partner was responsible for the disruption (Primo et al., 2007). Arguably, the nature of this commitment is calculative, and it is based on rational and economic considerations. In contrast to affective commitment, calculative commitment has been reported to be precarious and short-lived (Gundlach, Achrol, & Mentzer, 1995), which suggests that bridging decisions made under the constraints of dependence are likely to be negatively related to subsequent relationship satisfaction.

Drawing on Daft and Weick's (1984) distinction between active and passive firms and on a review of the extant supply chain risk management literature, we introduced the concept of supply chain disruption orientation. The proposed construct encompasses a firm's general awareness and consciousness of, concerns about, seriousness toward, and recognition of opportunity to learn from supply chain disruptions. From the three factors hypothesized to directly affect buffering and bridging, supply chain disruption orientation seems to have the greatest effect. Thus, a high supply chain disruption orientation makes firms more likely to craft and execute a specific response for reducing the likelihood and impact of future supply chain disruptions. This finding is consistent with those of previous studies emphasizing the importance of firm orientations and cultural traits in enhancing a firm's capabilities for dealing with adverse events (Edmondson, 1996; van Dyck et al., 2005). Moreover, prior research has shown that quick and precise responses to environmental changes are linked to superior performance. For example, firms that rapidly alter their structures, decision-making rou-

tines, and information processing approaches in response to changes in their task environment perform better over their lives than firms that change gradually (Miller & Friesen, 1982). As a consequence, a strong supply chain disruption orientation could represent a competitive advantage.

Finally, this study indicates that the relationship between factors that create motivation to act and the resulting response is not straightforward. Per the information processing perspective, the choice between buffering and bridging is not governed by the dominant functional demand (stability), but rather by interpretative postures that result from past experiences. Therefore, we examined the complex interaction effects of trust (experience with the exchange partner) and prior experience with supply chain disruptions to provide a richer understanding of what leads firms to pursue buffering or bridging strategies. The findings reveal that high levels of trust increase the sensitivity of an organizational response to the impact of a disruption, whereas low levels of trust weaken this direct effect. This pattern is counterintuitive, as trust has been viewed as a sentiment that may create strategic blindness (Krishnan, Martin, & Noorderhaven, 2006; McEvily, Perrone, & Zaheer, 2003). Pursuing this line of thought, one would expect that high levels of trust reduce responsiveness to the supply chain disruption and lead a focal firm to strengthen the relationship by engaging in bridging instead of buffering. Figures 2A and 2B, however, depict the opposite of this prediction. In the investigated setting, a lack of trust resulted in high levels of buffering and low levels of bridging, but when trust level was high, the effect of disruption impact on the pursuit of buffering and bridging was not suppressed, but magnified. In short, low levels of trust, not high levels, seem to weaken the effect of disruption impact on organizational response. This finding provides an important extension to the extant literature on interorganizational trust. At low levels of trust, a supply chain disruption confirms prior beliefs, whereas at high levels of trust, prior beliefs are challenged. Firms that showed high predisruption trust in their exchange partners seem to employ "trust-but-verify" strategies (within buffering and bridging) in the wake of disruptions.

The two hypotheses addressing the moderating role of trust on the direct effect of dependence on buffering and bridging were partially supported. The results failed to support the prediction that trust moderates the relationship between dependence on the exchange partner and buffering. However, we postulated and found that trust moderates the relationship between dependence and bridging. Figure 2C reveals that the interaction of dependence and trust follows an antagonistic model (Cohen et al., 2003). In keeping with resource dependence theory, a firm's trust in partner becomes irrelevant to the pursuit of bridging at very high dependence levels—that is, when the relationship with the partner is crucial for the firm's survival. No matter whether or not the firm trusts its partner, it will be increasingly forced to pursue bridging. Likewise, at very high levels of trust, the focal firm pursues bridging approaches irrespective of the level of dependence. This result is consistent with prior research on interfirm relationships that has demonstrated the relevance of trust for commitment, long-term orientation, and stability (Ganesan, 1994). In sum, the combined view that dependence and trust are alternative coordination mechanisms represents a corollary to resource dependence theory that does not explicitly or implicitly address trust (Ireland & Webb, 2007).

The investigation of prior experience as a moderating variable addresses an important claim in the information processing literature, namely that relevant prior experiences affect interpretation of environmental events (Daft & Weick, 1984; Huber, 1991). The hypothesized interaction effect between prior experience and disruption impact on the pursuit of buffering and bridging was supported. This suggests that a firm's prior experiences provide a lens through which the interpretation of a disruption impact becomes more accurate, thus leading to a better calibration of the firm's response decisions. In addition, our expectation that prior experiences moderate the relationship between supply chain disruption orientation and the focal firm's response was supported. The significant moderations reveal an intriguing effect when one compares Figures 2F (buffering) and 2G (bridging). The plots illustrate that active and passive firms draw completely different learning experiences from supply chain disruptions. As hypothesized, active firms with little experience seek additional information by pursuing a bridging strategy. But with an increasing amount of experience, they tend to pursue buffering approaches (Galbraith, 1973, 1977). In contrast, passive firms initially continue using buffering, as they may not realize that it is ineffective and that they need to explore new knowledge (Isabella, 1990). With increasing prior experience, however, their focus shifts from buffering to bridging strategies, as they attempt to gain stability in collaboration with their exchange partners.

Managerial Implications

This study has four important messages for managerial practice. First, purchasing managers should

be careful in relationships in which dependence on a specific supplier is high. Although this point appears obvious, the findings shed new light on this issue, namely that high dependence on an exchange partner substantially constrains a firm's span of responses in the aftermath of a supply chain disruption. Closely related to this point, this research provides managers with insights into when either buffering or bridging strategies are typical responses to supply chain disruptions. As supply chain disruptions are increasingly frequent (World Economic Forum, 2008), an important task of supply chain managers has become providing meaningful interpretations of these disruptions. Second, managers can improve their firm's supply chain disruption response capabilities by cultivating a strong supply chain disruption orientation. This study points out that preoccupation with preventing failure, continuous improvement processes, and a commitment to learn from supply chain disruptions help a firm to become more responsive to them. Third, the results pertaining to the moderating effect of prior experience make a strong case for organizational learning from supply chain disruptions. However, firms should not wait for a serious disruption before they learn how to understand latent vulnerabilities. A process of inquiry seeking latent deficiencies should be preventively initiated. Fourth, our hypotheses were built on the assumption that information influences firms' behavior. Thus, the exchange partners involved can attempt to exert influence on the response-crafting processes of the focal firms to channel their responses in a desirable direction. For example, if a supplier actively supports a focal firm in resolving a disruption, the perception of trust and dependence could be affected.

Limitations and Future Research Directions

Several limitations of this study should be considered in the interpretation of its results. Despite the encouraging results of the tests reported here, a few obvious limitations pertain to our data collection: (1) the rather low response rate is a potential weakness, (2) only one industry sector (manufacturing) was surveyed, (3) only one side of the supplier-buyer relationship dyad was considered, and (4) except for the control variables, we were unable to draw on objective data. In summary, this is a call for replication in other industries, which would increase the generalizability of the results, and for collection of data from both sides of relationship dyads, which would allow for a further analysis of the interorganizational nature of supply chain disruptions (Klein, Rai, & Straub, 2007). Furthermore, we used information processing as a theoretical concept to explain relationships between observable variables and outcomes, but we did not directly measure interpretations of supply chain disruptions or motivation to act. Thus, this study cannot provide direct evidence that organizational response is based on the proposed concepts. Finally, as performance aspects were not in the scope of this study, normative statements about how firms should respond to supply chain disruptions cannot be inferred from our results.

Several additional directions for future research can be highlighted. The results provide a basis for further investigations of buffering and bridging strategies, particularly for an analysis of their comparative efficiency and effectiveness. Moreover, the examination of the interplay of buffering and bridging seems promising. Although we did not find a significant correlation between the two strategies, there may be a temporal ordering wherein a focal firm progresses from less to more intense responses. For example, the firm may initially react with bridging and later respond with buffering, or vice versa. Therefore, we suggest longitudinal studies that examine the dynamic nature of organizational responses to supply chain disruptions.

Insufficient attention to the risk of supply chain disruption is a constant threat in firms, because managers generally do not get credit for preventing problems that never occur, especially if the potential consequences are not known in advance. This consideration leads to the question of whether firms, over the course of time, forget what they have learned from prior supply chain disruptions (Hedberg, 1981). Finally, factors beyond those incorporated in our hypotheses are likely to affect a firm's responses to a supply chain disruption (e.g., strategic orientation, organizational inertia). The same applies to environmental factors. Although our data were collected during a rather "normal" business time, it would be very interesting to examine how organizational responses to supply chain disruptions are shaped during more turbulent times.

Conclusion

A great deal of research has focused on the antecedents of supply chain disruptions, but the question of what happens *after* a disruption has received scant attention. More specifically, why, how, and under what conditions do firms respond to disruptions? Driven by these questions, this study extends the related literature in several significant ways. First, we establish that buffering and bridging are generic, yet distinct, coping strategies invoked in response to supply chain disruptions.

From this basis, we develop a model that opens the black box of organizational responses to supply chain disruptions and disentangles the critical factors that shape these responses. The proposed model provides insights into (1) the creation of motivation to act and (2) the conditions under which this motivation is channeled into the response alternatives of buffering and bridging. Second, we present the first systematic empirical investigation of organizational responses to supply chain disruptions. The findings lead to new insights into how inter- and intrafirm factors affect the meaning that a firm attaches to a disruption. Specifically, we demonstrate that, depending on the level of trust in the exchange partner involved, the occurrence of a supply chain disruption leads to different information processing needs and different responses. Third, we introduce the construct of supply chain disruption orientation to the supply chain management literature. We hope that future studies will refine this construct as well as understanding of supply chain disruptions and their management in general.

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APPENDIX A
Multi-item Measurement Scales

TABLE A1
Items and Indicators[a]

Measure and Items	α	Composite Reliability	λ	t	s.e.	Indicator Reliability
Disruption impact	.71	–[c]				
How did the disruption negatively affect (directly or indirectly) your business unit on the following dimensions in a short-run? (1, "not at all"; 5, "to a very large extent").						
IMP1 Procurement costs/Prices for the purchased item.			–[c]	–[c]	–[c]	–[c]
IMP2 Overall efficiency of our operations.			–[c]	–[c]	–[c]	–[c]
IMP3 Product quality of our final product(s).			–[c]	–[c]	–[c]	–[c]
IMP4 Responsiveness to customer demands.			–[c]	–[c]	–[c]	–[c]
IMP5 Delivery reliability (on-time delivery, order accuracy).			–[c]	–[c]	–[c]	–[c]
IMP6 Sales.			–[c]	–[c]	–[c]	–[c]
Dependence (prior to the disruption) (Jap & Ganesan, 2000)	.90	.95				
Please indicate your opinion on the following statements referring to the relationship with this supplier (1, "strongly disagree"; 5, "strongly agree").						
DEP1 If our relationship with this supplier had been discontinued, we would have had difficulty achieving our goals.			0.80	–[b]	–[b]	.84
DEP2 It would have been difficult for us to replace this supplier.			0.93	22.72	0.05	.92
DEP3 We were quite dependent on this supplier.			0.84	19.98	0.06	.86
DEP4 We did not have a good alternative to this supplier.			0.76	17.38	0.06	.73
Supply chain disruption orientation	.72	.82				
Please indicate your opinion on the following statements referring to your business unit (1, "strongly disagree"; 5, "strongly agree").						
DOR1 We feel the need to be alert for possible supply chain disruptions at all times.			0.61	–[b]	–[b]	.58
DOR2 Supply chain disruptions show us where we can improve.			0.61	8.57	0.13	.51
DOR3 We recognize that supply chain disruptions are always looming.			0.48	8.35	0.08	.52
DOR4 We think a lot about how a supply chain disruption could have been avoided.			0.70	10.24	0.12	.65
DOR5 After a supply chain disruption has occurred, it is analyzed thoroughly.			0.56	7.87	0.16	.37
Trust (prior to the disruption) (Doney & Cannon, 1997)	–[c]	–[c]				
Please indicate your opinion on the following statements referring to the relationship with this supplier (1, "strongly disagree"; 5, "strongly agree").						
Credibility (prior to the disruption)	.85	.94	0.77	–[b]	–[b]	–[b]
TRU1 This supplier was always honest with us.			0.81	–[b]	–[b]	.81
TRU2 We were confident in the information that this supplier provided us.			0.76	16.96	0.05	.82
TRU3 This supplier was trustworthy.			0.88	19.15	0.05	.89
Benevolence (prior to the disruption)	.74	.86	0.98	5.22	0.17	–[b]
TRU4 This supplier was genuinely concerned that our business succeeds.			0.53	–[b]	–[b]	.42
TRU5 When making important decisions, this supplier considered our welfare as well as its own.			0.79	10.46	0.13	.77
TRU6 We trusted this supplier to keep our best interests in mind.			0.83	10.69	0.13	.80
Buffering (after the disruption)	.69	.81				
Since the disruption, to what extent has your business unit pursued, or made plans to pursue, the following activities? (1, "not at all"; 5, "to a very large extent").						
BUF1 Make us more independent of this supplier or the purchased item.			0.86	–[b]	–[b]	.64
BUF2 Increase our protective barriers against disturbances in the supply of the purchased item.			0.38	7.06	0.05	.44
BUF3 Search for or develop one or more alternative supplier(s) for the purchased item.			0.74	10.00	0.09	.65

TABLE A1
(Continued)

Measure and Items	α	Composite Reliability	λ	*t*	s.e.	Indicator Reliability
Bridging (after the disruption)	.89	.95				
Since the disruption, to what extent has your business unit pursued, or made plans to pursue, the following activities? (1, "not at all"; 5, "to a very large extent")						
BRI1 Establish a closer relationship with this supplier in order to collaborate better in case of supply chain disruptions.			0.80	–[b]	–[b]	.83
BRI2 Tighten the control mechanisms on this supplier (e.g., more monitoring).			0.71	15.81	0.06	.70
BRI3 Cooperate more intensively with this supplier.			0.89	21.50	0.05	.91
BRI4 Improve information exchange with this supplier.			0.87	20.65	0.05	.91
BRI5 Engage in risk management activities with this supplier (e.g., development of joint contingency plans).			0.67	14.84	0.06	.63
Competitive intensity (Jaworski & Kohli, 1993)	.74	.83				
Please indicate your opinion on the following statements concerning the market for the given product line (1, "not at all"; 5, "to a very large extent")						
CPI1 The business climate for the final product(s) is very competitive.			0.54	–[b]	–[b]	.50
CPI2 Anything that one competitor can offer others can match readily.			0.45	7.62	0.13	.30
CPI3 Competition in this industry is cutthroat.			0.75	10.05	0.15	.70
CPI4 Winning in this marketplace is a tough battle.			0.85	10.31	0.16	.74

[a] "λ" refers to the standardized factor loading; s.e.'s are asymtotically robust estimates; *t*'s are from the unstandardized solution. All factor loadings are significant at $p < .001$ (two-tailed).
[b] Factor loading was fixed at 1.0 for identification purposes.
[c] Indicator is not appropriate for formative measures, single-item measures, or second-order factors.

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