

S Y M P O S I U M

SECOND-ORDER DYNAMIC CAPABILITIES: HOW DO THEY MATTER?

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Similar to the fairly well-established distinction between substantive capabilities and dynamic capabilities, a further distinction can be made between first-order dynamic capabilities (which have been the subject of much interest and debate over the past two decades) and second-order dynamic capabilities (which have received considerably less attention thus far). Based on a large-scale survey study in the context of strategic alliances, this paper empirically examines second-order dynamic capabilities in two ways. First, I find that, for the most part, the performance effect of second-order dynamic capabilities is indirect and mediated by first-order dynamic capabilities. Second, results show a negative interaction between first- and second-order dynamic capabilities, suggesting that they function as substitutes in affecting performance outcomes. These findings contribute to a better understanding of the interplay between levels of the dynamic capabilities hierarchy.

Dynamic capabilities have become a key topic in management research in recent years (Di Stefano, Peteraf, & Verona, 2010; Di Stefano, Peteraf, & Verona, 2014; Easterby-Smith, Lyles, & Peteraf, 2009). In general, research on dynamic capabilities is interested in how firms build and adapt their resource base to maximize organizational fit with the environment. One of the distinctive features of the dynamic capabilities perspective is the notion that such adaptation can be based on organizational routines—learned, repetitious behavioral patterns for interdependent corporate actions (Di Stefano et al., 2014; Helfat & Peteraf, 2003; Pierce, Boerner, & Teece, 2002; Winter, 2003).

But if dynamic capabilities are reflected by organizational change routines, how do firms build and adapt such routines? Some capabilities scholars have suggested that they do so by employing second-order dynamic capabilities that operate on the firm's first-order dynamic capabilities (Collis, 1994; Zollo & Winter, 2002). Conse-

quently, a distinction can be made between first-order dynamic capabilities (routines that reconfigure the organizational resource base) and second-order dynamic capabilities (routines that reconfigure first-order dynamic capabilities). Introducing this distinction enhances theoretical precision by specifying what it is that the organizational routine aims to change.

Although this hierarchy of dynamic capabilities seems to be generally accepted in the literature (e.g., Ambrosini, Bowman, & Collier, 2009; Easterby-Smith et al., 2009; Easterby-Smith & Prieto, 2008; Robertson, Casali, & Jacobson, 2012), we still lack detailed knowledge of exactly how first- and second-order dynamic capabilities are intertwined. In particular, there is a dearth of empirical work investigating the role of second-order dynamic capabilities in conjunction with first-order dynamic capabilities (Peteraf, Di Stefano, & Verona, 2013).

This article aims to address this gap in two ways. First, I investigate whether second-order dynamic capabilities have an indirect performance effect that is mediated by first-order dynamic capabilities (as would be the case if the central function of the former is to develop the latter). Second, I explore how first- and second-

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order dynamic capabilities jointly influence organizational performance outcomes.

I examine these issues empirically in the context of strategic alliances. Because they give firms access to resources that lie outside their boundaries, alliances serve as an important instrument for augmenting the organizational resource base (Das & Teng, 2000). Consequently, alliance management capability is widely recognized as a prime example of a first-order dynamic capability (e.g., Anand, Oriani, & Vassolo, 2010; Helfat & Winter, 2011; Schilke & Goerzen, 2010). Further, important progress has been made in conceptualizing alliance learning routines as a second-order dynamic capability (Kale & Singh, 2007, 2009; Zollo & Winter, 2002). For these reasons, the context of strategic alliances makes an ideal setting for this study.

SECOND-ORDER DYNAMIC CAPABILITIES

Interest in dynamic capabilities stems from their potential for enhancing organizational performance outcomes. By adapting the resource base, dynamic capabilities can create better matches between the configuration of a firm's resources and external environmental conditions (Teece, Pisano, & Shuen, 1997; Zahra, Sapienza, & Davidsson, 2006). Further, dynamic capabilities are heterogeneously distributed and thus fulfill a key requirement for being a source of competitive advantage (Peteraf, 1993; Peteraf & Barney, 2003). For example, idiosyncratic firm-level differences exist in the timing of building dynamic capabilities and in the nature and the amount of investment firms undertake (Ethiraj, Kale, Krishnan, & Singh, 2005; Teece, 2014). Indeed, several empirical studies report a significant positive relationship between a firm's dynamic capabilities and performance (e.g., Morgan, Vorhies, & Mason, 2009; Schilke, 2014; Stadler, Helfat, & Verona, 2013).

Because the concept of dynamic capabilities is significant for firm performance, it is important to understand the sources of such capabilities. Earlier efforts focused on identifying and defining dynamic capabilities and their effects (Easterby-Smith et al., 2009; Helfat & Peteraf, 2009), yet we know less about how these capabilities emerge and are kept from stagnating over time. Put another way, why does one firm have strong dynamic capabilities while another does not?

Dynamic capabilities usually cannot be acquired in factor markets; therefore, they have to be devel-

oped internally (Helfat, Finkelstein, Mitchell, Peteraf, Singh, & Teece, 2007; Katkalo, Pitelis, & Teece, 2010; Maritan & Peteraf, 2011; Teece, 2014). Researchers have recently drawn from a variety of approaches to identify several different factors that foster the development of (first-order) dynamic capabilities (e.g., Cabiddu, 2010; Danneels, 2008; Kahl, 2014), but particular theoretical interest has focused on one specific origin: namely, second-order dynamic capabilities.

Collis (1994) was the first to advocate that capabilities can exist on various levels. At the most fundamental level, capabilities refer to the routines that enable firms to deploy their resources to earn a living in the present; these capabilities are sometimes also called ordinary, substantive, or zero-order capabilities (Winter, 2003; Zahra et al., 2006). At the next level are capabilities that allow the firm's fundamental capabilities and resources to change; these are commonly referred to as (first-order) dynamic capabilities (Eisenhardt & Martin, 2000; Teece et al., 1997). At an even higher level of abstraction, Collis (1994) identified second-order dynamic capabilities as those that can be used to develop first-order dynamic capabilities.

Zollo and Winter (2002) elaborated this idea further, particularly emphasizing the importance of organizational learning routines as the mechanism underlying second-order dynamic capabilities. The authors built on existing learning theories to suggest that deliberate learning efforts based on selection and retention (Gavetti & Levinthal, 2000) become routinized over time as they are stored in the organization's procedural memory (Cohen & Bacdayan, 1994). While learning routines have always been considered an important component of first-order dynamic capabilities (Mahoney, 1995; Teece et al., 1997), they are at least as important—or even more so—when developing these capabilities (Easterby-Smith & Prieto, 2008; Kianto & Ritala, 2010). In this sense, second-order dynamic capabilities can be thought of as “learning-to-learn” capabilities (Collis, 1994);¹ they are sometimes also referred to as meta or regenerative dynamic capabilities (Ambrosini et al., 2009). Examples of relevant learning efforts on which second-order dynamic capabilities

¹ Of course, second-order capabilities could also be about “learning to unlearn,” in the sense that reconfiguration of first-order dynamic capabilities may also involve deliberate deinstitutionalizing certain first-order routines.

are based include deliberate analysis of what aspects of the current first-order dynamic capabilities do and don't work, codification of past experience, and transfer of relevant knowledge within the organization (Heimeriks, Schijven, & Gates, 2012; Helfat et al., 2007; Zollo & Winter, 2002).

These activities underlying second-order dynamic capabilities resemble many of the elements of Nonaka's (1994) knowledge spiral, in which organizational knowledge is embedded and institutionalized within the organization while also continually developing. The idea of learning to learn is also strongly related to Argyris and Schön's (1978) concept of double-loop learning, which involves scrutinization of organizational learning systems. Moreover, as Ambrosini and colleagues (2009) noted, the logic of change processes altering existing change processes is also evident in the change management literature (e.g., Watzlawick, Weakland, & Fisch, 1974). As such, the concept of second-order dynamic capabilities is strongly anchored in adjacent fields of research.

CONSEQUENCES OF SECOND-ORDER DYNAMIC CAPABILITIES

So far, relatively little attention has been paid to studying the specific consequences of second-order dynamic capabilities. In particular, empirical tests are scarce (cf. Peteraf et al., 2013). One notable exception is a study by Macher and Mowery (2009), who explored the impact of second-order dynamic capabilities (represented by deliberate learning mechanisms) on new process development in semiconductor manufacturing. They provided evidence that experience accumulation, knowledge articulation, and knowledge codification can yield superior new process development and introduction performance. Relevant insight also comes from research by Zollo and Singh (2004), who studied the role of deliberate learning in post-acquisition integration (also see Zollo & Leshchinskii, 2000). Using data on acquisitions in the banking industry, they showed that the degree of codification of acquisition-specific knowledge can improve post-acquisition performance. Finally, Kale and Singh (2007) analyzed learning processes in the context of alliance management. Using survey data from alliances among U.S.-based firms, they found a positive relationship between the alliance learning process and firm-level alliance success.

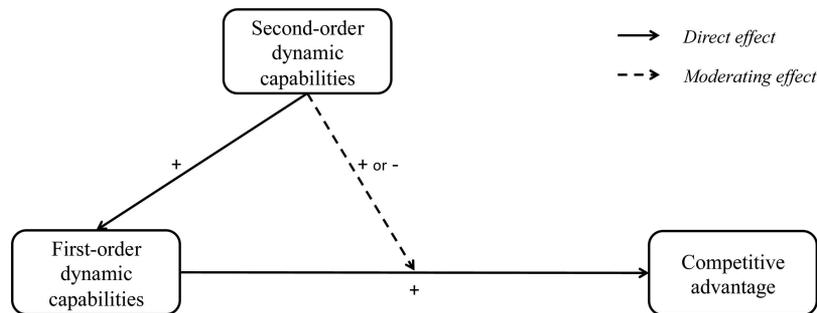
Overall, these studies have made important contributions to our understanding of the nature of second-order capabilities in various management and industry contexts. However, all of these studies failed to provide evidence for a mediated model, in which second-order dynamic capability would affect first-order dynamic capability; instead, they investigated only the second-order capability's effect on performance. Put differently, although these studies were able to establish a positive link between second-order dynamic capabilities and performance outcomes, they did not show whether the performance improvements are indeed due to a change in first-order dynamic capabilities or whether the second-order dynamic capabilities have a direct performance effect that is largely independent of first-order dynamic capabilities.

I agree with Ambrosini and colleagues (2009), who emphasized the importance of understanding the distinctive mechanism through which second-order dynamic capabilities exert an effect. Only by establishing that deliberate learning routines influence performance *through the development of first-order dynamic capabilities* can one be sure to actually get at second-order dynamic capabilities. In other words, theoretical accounts imply that one of the distinctive features of second-order dynamic capabilities is that they do not improve performance directly but rather work indirectly by embedding first-order dynamic capabilities into the firm. This logic suggests a mediation model, with first-order dynamic capabilities mediating the impact of second-order dynamic capabilities on performance.

In addition to this possible two-step causal chain (from second-order dynamic capabilities to first-order dynamic capabilities to performance outcomes), another interesting question to consider is whether these capabilities also have interactive effects on performance (see Figure 1).² While such a structure has never been formally proposed, a moderation model can be derived from extant discussions. More specifically, two opposing perspectives can be construed regarding how first- and second-order dynamic capabilities jointly affect perfor-

² Two different models are examined here. Whereas the mediation model tests whether second-order dynamic capabilities lead to an *increase* in first-order dynamic capabilities, the interaction/moderation model tests whether second-order dynamic capabilities affect the *effectiveness* of first-order dynamic capabilities in increasing performance.

Figure 1
Theoretical Framework



mance: They could work either as complements or as substitutes.

Generally, two activities are understood to be complements if the marginal benefit of each of the activities increases in the presence of the other (e.g., Rothaermel & Hess, 2007). In contrast, two activities are understood to interact as substitutes if the marginal benefit of each of the activities decreases in the presence of the other. In statistical terms, two variables are complements if their interaction term has a positive effect and are substitutes if their interaction term has a negative effect.

A positive interaction between second- and first-order dynamic capabilities might be considered likely because second-order dynamic capabilities may help firms better understand and thus better perform their first-order dynamic capabilities (Argote, 1999; Cepeda & Vera, 2007). More pronounced second-order dynamic capabilities may thus produce greater awareness of available approaches and specific ways of effectively performing first-order dynamic capabilities. In addition to increasing effectiveness, codification of knowledge into procedures and technologies may also make lower-order change routines easier, and thus more efficient, to apply (Cepeda & Vera, 2007; Zander & Kogut, 1995). Further, second-order dynamic capabilities may enable a firm not only to better understand first-order dynamic capabilities but also to prevent their misapplication (Heimeriks et al., 2012). These arguments suggest that first-order dynamic capabilities are more effective in supporting competitive advantage if combined with second-order dynamic capabilities.

In contrast to this view, there is also reason to believe that the two types of dynamic capabilities may function as substitutes for each other. The theoretical foundation for this argument is that dynamic capabilities on both levels are predominantly employed to attain the similar end of strate-

gic change and thus may exhibit some element of equifinality (see Rothaermel & Hess, 2007, for a similar argument regarding dynamic capabilities located at individual, firm, and network levels of analysis). Perhaps more important, while second-order dynamic capabilities expand the organization's first-order dynamic capabilities, such expansion may come at the risk of disturbing the smooth execution of first-order dynamic capabilities, thus decreasing their effectiveness on the margin. Analogous to the reasoning that pronounced first-order dynamic capabilities hamper resource effectiveness if they cause too much change in the resource base (Schilke, 2014; Winter, 2003; Zahra et al., 2006), second-order dynamic capabilities may cause disruptions in the ongoing usage of first-order dynamic capabilities. The above arguments, although tentative, imply a substitution effect between first- and second-order dynamic capabilities.

To recapitulate, researchers have developed a sound theoretical understanding of what second-order dynamic capabilities are. Most notably, they have brought attention to deliberate learning routines as a particularly relevant type of second-order dynamic capability. While empirical research on second-order dynamic capabilities is scarce, a few studies have observed them in contexts such as new process development, acquisition integration, and strategic alliances. These studies have also shed initial light on their performance effects, examining the direct relationship between second-order dynamic capabilities and organizational outcomes. From a theoretical perspective, however, such an effect should be explained by first-order dynamic capabilities, suggesting a structure of a mediation model, which so far has remained largely unexplored. Another open question regarding the consequences of second-order dynamic capabilities pertains to their interaction with first-order dynamic capabilities: Specifically, do first- and

second-order dynamic capabilities work as complements or substitutes in enhancing a firm's performance? While conceptual arguments for both views can be identified, deciding on the more appropriate account solely on theoretical grounds is difficult.

The empirical study reported in this paper aims to address these open issues. It uses a data set previously employed by Schilke (2014) to further investigate the relationships among second-order dynamic capabilities, first-order dynamic capabilities, and performance. Situated in the context of strategic alliances, a first-order dynamic capability is conceptualized in terms of alliance management capability, while alliance learning represents the study's focal second-order dynamic capability. Having data on both types of capabilities and alliance portfolio performance as the outcome variable allows me to test a mediation as well as a moderation model, consistent with the foregoing theoretical discussion and with the framework presented in Figure 1.

METHODOLOGY

Data

As mentioned above, this study leverages a data set used in a previous study. Only the key characteristics of the data are summarized here (for a more detailed description, please see Schilke, 2014). In brief, the data collection comprised three stages: (1) qualitative field interviews that helped to sharpen my theoretical understanding and aided in the development of a survey instrument, (2) a large-scale survey, and (3) a follow-up survey in which I collected data on the study's dependent variable.

Consistent with the relationship criterion commonly applied in alliance research (Koka & Prescott, 2002), the survey sample was restricted to firms that were currently engaged in R&D alliances. Following Eisenhardt and Schoonhoven (1996), I focused on alliances in R&D because of the diversity of forms of alliances and because R&D alliances are typically more strongly geared toward resource reconfiguration than some other types of alliances (e.g., production or marketing alliances). I targeted firms from the chemicals (23%), machinery (54%), and motor vehicle (23%) industries primarily because R&D alliances are frequent in these sectors (Hagedoorn, 1993). Of the 1,386 firms that qualified for participation in the study based on the criteria outlined above, 302 provided usable responses.

I collected the outcome variable of alliance portfolio performance in a follow-up survey three years

later to enhance causal inference (Biddle, Slavings, & Anderson, 1985) and to reduce concerns about common method bias (Podsakoff & Organ, 1986). After several reminders, I obtained 279 completed questionnaires matched across both survey waves. The respondents, who passed several tests for key informant appropriateness (Kumar, Stern, & Anderson, 1993), were predominantly senior R&D managers. Several statistical tests suggested that neither nonresponse bias nor common method bias was a serious problem with the data.

Measures

Where possible, the measures for this study were based on existing instruments. An initial item pool was thoroughly pretested and, when necessary, modified. As described in Schilke (2014), I was able to validate several of the survey measures with complementary data sources that allowed me to assess key informant accuracy (Homburg, Klarman, Reimann, & Schilke, 2012). All measurement items, except for some of the control variables, were formulated as Likert-type statements anchored by a seven-point scale, ranging from 1 ("strongly disagree") to 7 ("strongly agree").

Performance outcome. Consistent with prior alliance research building on the capabilities approach (Heimeriks & Duysters, 2007; Kale & Singh, 2007; Schilke & Goerzen, 2010), this study uses *alliance portfolio performance* as the key outcome variable because alliance-related capabilities can be expected to influence not only individual alliances but the entire portfolio of the firms' alliances. Alliance portfolio performance was operationalized in terms of performance satisfaction and perceived goal fulfillment of the firm's R&D alliances. A four-item scale was adopted from Schilke and Goerzen (2010).

Second-order dynamic capability. In line with Zollo and Winter (2002) and Kale and Singh (2007), I included *alliance learning* as the focal second-order dynamic capability. The three-item scale, which builds on an earlier survey measure by Emden, Yaprak, and Cavusgil (2005), included the following items: "We conduct periodic reviews of our R&D alliances to understand what we are doing right and where we are going wrong," "We regularly collect and analyze field experiences from our R&D alliances to learn from the past for the future," and "We diligently transfer know-how on R&D alliance 'dos' and 'don'ts' to key managers."

First-order dynamic capability. Following Schilke (2014), *alliance management capability* can be defined as a “type of dynamic capability with the capacity to purposefully create, extend, or modify the firm’s resource base, augmented to include the resources of its alliance partners” (Helfat et al., 2007, p. 66). I used the five-dimensional measure developed by Schilke and Goerzen (2010), which comprises the dimensions of interorganizational coordination, alliance portfolio coordination, interorganizational learning, alliance proactiveness, and alliance transformation.

Controls. I included a variety of control variables in the models. First, *industry* effects were controlled for by including dummies for machinery and motor vehicles (chemicals served as the base dummy). Second, a control for *firm age* measured the years since the firm was established, classified into six categories (from 1 for firms younger than five years to 6 for firms 50 years or older). Third, a similar categorical measure was included for *firm size*, which ranged from 1 for firms with fewer than 100 employees to 6 for firms with 5,000 or more employees. Fourth, *alliance portfolio size* was measured as the logarithmized number of the firm’s current alliances. Fifth, I controlled for two key dimensions of the firm’s strategy by including measures for *product scope* and *market scope* (Zott & Amit, 2008). Sixth, because responses from diversified organizations pertained to a specific business unit, whereas more focused organizations’ responses pertained to the entire firm, I included a dummy called *firm unit of analysis* (1 = firms and 0 = business units) to account for this difference. Finally, because in some cases the key informant in the follow-up survey differed from the informant who had participated in the first survey, another dummy was coded as 1 when the *same respondent* participated in both waves of data collection.

Validity and reliability. The constructs’ coefficient alphas, composite reliabilities, and average variances extracted invariably exceeded common thresholds, suggesting reliable and valid measurement of the individual constructs. I also ran a confirmatory factor analysis among all first-order constructs using structural equation modeling. The global fit criteria indicated a good overall model fit ($\chi^2/df = 1.43$; CFI = 0.96; GFI = 0.89; TLI = 0.95; RMSEA = 0.04). Based on the procedure introduced by Fornell and Larcker (1981), discriminant validity was satisfactory, as the square root of the

average variance extracted by the measure of each factor was larger than the absolute value of the correlation of that factor’s measure with all measures of other factors in the model.

RESULTS

To test the suggested mediation and moderation models, I used ordinary least squares regression analysis. Before running the regressions, I created simple averages of the items for each construct. Table 1 presents the regression results. In the table, models 1–4 use alliance portfolio performance as a dependent variable, while model 5 uses alliance management capability. Model 1 includes controls only. Model 2 also considers alliance learning and model 3 alliance management capability as predictors. Model 4 also incorporates a linear interaction term between alliance management capability and alliance learning (both variables were standardized before constructing this interaction term). Model 5, which predicts alliance management capability, specifies the effects of all controls as well as alliance learning.

I first inspected the regression results with regard to a possible mediation structure. According to the standard analytic procedure proposed by Baron and Kenny (1986), three conditions are necessary for the presence of a mediation effect: (a) The independent variable (in this case, alliance learning) must significantly affect the dependent variable (alliance portfolio performance) while *not* controlling for the mediator (alliance management capability); (b) the independent variable (alliance learning) must significantly affect the mediator (alliance management capability); and (c) the mediator (alliance management capability) must significantly affect the dependent variable (alliance portfolio performance) after the influence of the independent variable (alliance learning) is controlled for.

The presence of condition (a) can be inferred from the Table 1 model 2 results, which show a significant positive relationship between alliance learning and alliance portfolio performance ($b = 0.32$; $p \leq .01$). In support for condition (b), the results for model 5 indicate that alliance learning is significantly related to alliance management capability ($b = 0.41$; $p \leq .01$). Finally, the results for model 3 show a significant link between alliance management capability and alliance portfolio performance ($b = 0.58$; $p \leq .01$) while controlling for alliance learning, providing evidence for condition (c). Taken together, these

TABLE 1
OLS Regression Results

| Variables | Coefficient | Model 1 APP | Model 2 APP | Model 3 APP | Model 4 APP | Model 5 AMC |
|---|-----------------|--------------------------|---------------|----------------|----------------|---------------|
| Intercept | a | 4.20** (0.42) | 3.36** (0.40) | 1.61** (0.34) | 1.77** (0.35) | 2.55** (0.40) |
| <i>Controls</i> | | | | | | |
| Machinery | b ₁ | -0.37* (0.15) | -0.30* (0.13) | -0.28** (0.11) | -0.27* (0.11) | -0.01 (0.14) |
| Motor vehicles | b ₂ | -0.40* (0.18) | -0.25 (0.16) | -0.39** (0.13) | -0.39** (0.13) | 0.23 (0.16) |
| Firm age | b ₃ | 0.04 (0.04) | 0.05 (0.04) | 0.04 (0.03) | 0.03 (0.03) | 0.03 (0.04) |
| Firm size | b ₄ | 0.08 [†] (0.05) | 0.07 (0.04) | 0.03 (0.04) | 0.03 (0.04) | 0.07 (0.05) |
| Alliance portfolio size | b ₅ | 0.11 (0.07) | 0.02 (0.06) | -0.02 (0.05) | -0.01 (0.05) | 0.07 (0.06) |
| Product scope | b ₆ | 0.00 (0.04) | 0.00 (0.04) | 0.01 (0.03) | 0.00 (0.03) | -0.01 (0.04) |
| Market scope | b ₇ | 0.04 (0.04) | 0.05 (0.04) | 0.01 (0.03) | 0.02 (0.03) | 0.07 (0.04) |
| Firm unit of analysis | b ₈ | 0.06 (0.19) | 0.12 (0.17) | 0.17 (0.14) | 0.17 (0.13) | -0.09 (0.17) |
| Same respondent | b ₉ | 0.08 (0.13) | 0.07 (0.12) | 0.09 (0.10) | 0.09 (0.10) | -0.03 (0.12) |
| <i>Predictors</i> | | | | | | |
| Alliance learning | b ₁₀ | | 0.32** (0.04) | 0.08* (0.04) | 0.10* (0.04) | 0.41** (0.04) |
| Alliance management capability | b ₁₁ | | | 0.58** (0.05) | 0.54** (0.05) | |
| Alliance management capability × alliance learning | b ₁₂ | | | | -0.09* (0.04) | |
| R-squared | | 0.07 | 0.26 | 0.51 | 0.52 | 0.35 |
| Adjusted R-squared | | 0.03 | 0.24 | 0.49 | 0.50 | 0.32 |

Notes: APP = alliance portfolio performance; AMC = alliance management capability; $n = 279$; unstandardized coefficients and standard errors (in parentheses) are reported; [†] $p \leq .10$; * $p \leq .05$; ** $p \leq .01$.

findings indicate that alliance management capability mediates the effect of alliance learning on performance. Note that instead of full mediation only partial mediation is observed; in model 3, alliance learning still has a significant (although, in comparison with model 2, much weaker) effect on alliance portfolio performance ($b = 0.08$; $p \leq .05$). To assess more rigorously whether the (partial) mediation is statistically significant, I ran Sobel's (1982) test, the results of which were highly significant ($z = 7.55$; $p \leq .01$).

Subsequently, I screened the regression results with regard to the interactive effect of first- and second-order dynamic capabilities on performance. Model 4 reports the results for the moderated regression. In this model, both alliance management capability and alliance learning have significant main effects on alliance portfolio performance ($b = 0.54$; $p \leq .01$ and $b = 0.10$; $p \leq .05$, respectively). The negative and significant coefficient of their product term supports the substitution account; the positive effect of alliance management capability on alliance portfolio performance decreases with increasing alliance learning.

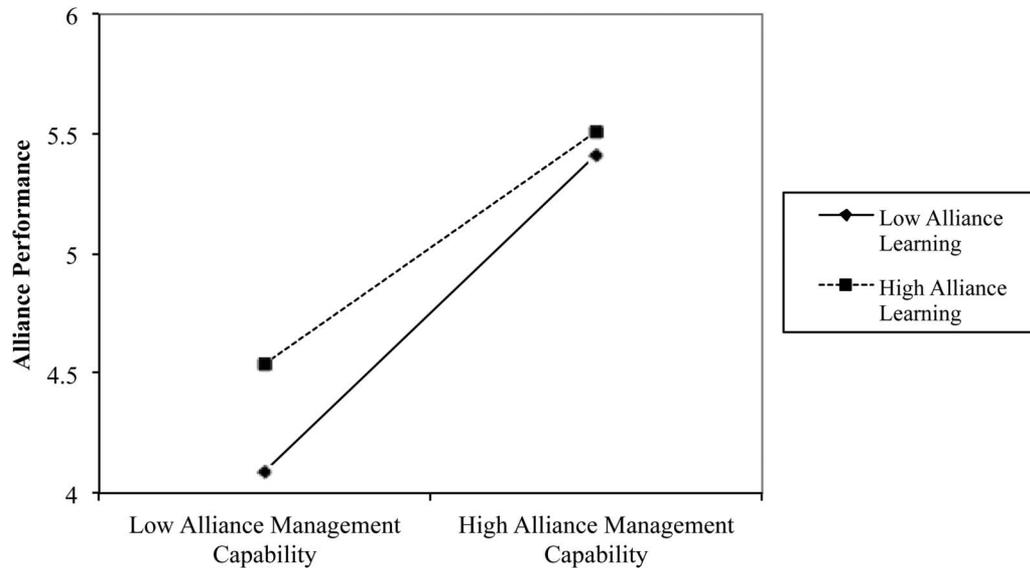
Figure 2 illustrates this moderation effect graphically. For this purpose, I split the variables (alliance management capability and alliance learning) into a low group (one standard deviation below the mean) and a high group (one stan-

dard deviation above the mean) (Aiken & West, 1991). Figure 2 shows that when alliance learning is low, alliance management capability has a steeper (i.e., stronger) positive effect on alliance portfolio performance than it has when alliance learning is high. Note, however, that the effect of alliance management capability is still highly positive and significant when alliance learning is high; it is just attenuated compared to the low alliance learning condition.

DISCUSSION

Following theoretical developments proposing a hierarchy of dynamic capabilities, this article set out to bring greater clarity to the concept of second-order dynamic capabilities and their consequences. To do so, I first synthesized extant discussions, which suggested (a) that second-order dynamic capabilities operate on the firm's first-order dynamic capabilities and (b) that deliberate learning routines represent an important type of second-order dynamic capability. Next, I argued that second-order dynamic capabilities should have an indirect impact on performance, an effect that is mediated by first-order dynamic capabilities. I then developed and juxtaposed alternate positions about a possible interactive effect of the two capabilities on performance; they could work either as complements or substitutes

FIGURE 2
Interaction Effect



Note: All regressors were standardized to create this figure.

in affecting organizational outcomes. Finally, I explored these ideas empirically using survey data on strategic alliances.

Taken together, the results not only support a mediation account, showing that first-order dynamic capabilities intervene in the performance effect of second-order dynamic capabilities, but also lend support to the notion that first- and second-order dynamic capabilities are substitutes for each other when it comes to their joint effect on performance. These overarching findings resulted from an attempt to answer questions pertaining to the specific consequences of second-order dynamic capabilities. Overall, this paper makes a significant contribution to the understanding of hierarchical order in dynamic capabilities as well as their joint performance implications—issues that have been brought up as particularly timely and important for the evolution of dynamic capabilities theory (Ambrosini et al., 2009; Arend & Bromiley, 2009). In particular, the findings reported here further support the merit of differentiating between first- and second-order dynamic capabilities.

Regarding the mediation model, the empirical results show that alliance learning (the second-order dynamic capability used in the study) has a significant but mostly indirect effect on performance by increasing the firm's alliance management capability (i.e., first-order dynamic capability). The positive performance effect of alliance

learning dropped substantially once alliance management capability was introduced to the model, indicating that significant mediation is present. Therefore, it is not primarily the second-order dynamic capability that drives performance; rather, this capability should be thought of mainly as an antecedent to a first-order dynamic capability, which in turn creates a competitive advantage in the firm's resource base.

An interesting finding is that the mediation, while highly significant, is only partial. That is, even after controlling for alliance management capability, alliance learning had a significant (albeit much smaller) coefficient. One possible interpretation of this result is that the act of codifying and scrutinizing current management practices not only aids in the development of a routine-based dynamic capability but might also foster ad hoc problem-solving strategies (cf. Bingham & Eisenhardt, 2011). Clearly, the question of whether and how second-order dynamic capabilities can help firms increase their performance in addition to increasing first-order dynamic capabilities should spark considerable interest in future researchers.

Another finding from the mediation analyses (specifically, from model 5) is that, while the impact of second- on first-order dynamic capability is positive and fairly strong ($b = 0.41$; $p \leq .01$), it is not deterministic. Thus, factors other than second-

order dynamic capabilities must help to develop first-order dynamic capabilities. This view parallels prior discussions of the relationship between first-order dynamic capabilities and the resource base; these capabilities are an important—but not the only—means to bring about resource change (Helfat & Peteraf, 2003, 2009; Winter, 2003). Taken together, these insights underpin the need for resource-based theorists to broaden their scope and embrace other perspectives (e.g., institutional theory, social cognition approaches) to more fully understand how dynamic capabilities and resources develop (Katkalo et al., 2010; Maritan & Peteraf, 2011; Peteraf, 2005; Pitelis, 2007).

Furthermore, this study provides novel findings regarding the interactive nature of dynamic capabilities at different hierarchical levels in affecting performance outcomes. Results show that first- and second-order dynamic capabilities interact in a substitutive way. With increasing levels of second-order dynamic capabilities, the marginal effect of first-order dynamic capabilities diminishes (and vice versa). This finding that second-order dynamic capabilities are both antecedents and substitutes of first-order dynamic capabilities may appear counterintuitive at first sight. As elaborated earlier, reasons for the negative interaction may pertain to disruptions of the first-order dynamic capabilities' smooth execution. That is, while acting upon and expanding first-order dynamic capabilities, second-order dynamic capabilities may at the same time disrupt ongoing resource change activities and thus disturb the execution of first-order dynamic capabilities (see Winter, 2003, p. 993, for a similar argument). Further empirical research, especially qualitative research, is necessary to help scholars better grasp the theoretical mechanisms responsible for the observed substitution effect.

As dynamic capabilities research advances and interest in higher-order dynamic capabilities continues to increase, should we go further by investigating third-order or even more abstract dynamic capabilities—the capabilities to change capabilities to change capabilities that change capabilities (and so on)? As is often the case, we are faced with a trade-off between accuracy and parsimony. Of course, we want the most realistic and complete picture of how strategic change comes about, but, at the same time, the principle of parsimony dictates that, *ceteris paribus*, the simplest explanation should be preferred.

One solution to the infinite-regress problem that has been discussed in the literature is to make a context-specific decision on whether capabilities at a more distant level of abstraction are relevant (Collis, 1994; Winter, 2003). This solution is similar to Coleman's (1990) notion of "natural stopping points," which suggests that an explanation is sufficiently fundamental for the specific problem at hand when more distant levels do not promise significant contributions to understanding system behavior. For example, highly abstract dynamic capabilities may not be highly relevant to competitive advantage or may not even exist in a very early stage of industry evolution, whereas, over time, the locus of relevant capabilities may rise to higher levels. In addition, distant dynamic capabilities may be less relevant in certain environmental contexts than in others. Thus, although it is admittedly rather ad hoc and somewhat unsatisfying, the pragmatic solution in empirical research is either to base the decision about the appropriate depth of the analyzed capability hierarchy on the researcher's own good judgment of the particular setting or to make the appropriate depth an empirical question in and of itself.

While this study makes several important contributions, it is not without limitations. First, the well-known shortcomings of a cross-sectional data set apply, including its limited ability to establish causality. Future studies should thus try to employ longitudinal data sets. Such studies may also be able to shed light on the question of whether the performance effects of dynamic capabilities at various levels are more pronounced in the short or long term. For example, it is possible that the negative interaction is comparatively stronger in the short run, with changes in first-order dynamic capabilities potentially having a greater payoff in the longer term. Further, this study focused on one particular context in which first- and second-order capabilities may exist—namely, the context of strategic alliances. It is up to future work to examine whether the results obtained here can be generalized to other types of dynamic capabilities, such as those in mergers and acquisitions (Chatterji & Patro, 2014) or internal restructuring (Kleinbaum & Stuart, 2014).

CONCLUSIONS

The dynamic capabilities view has evolved into one of the most influential approaches to

strategic management research of our time. Specifically, it complements the resource-based view by explaining where rent-generating resources (the key unit of analysis in resource-based theory) come from. In a way, “the resource-based view of the firm needs dynamic capabilities to explain how assets get deployed and how rent streams get extended and renewed” (Teece, 2014, p. 341).

But just as the resource-based view needs dynamic capabilities, the dynamic capabilities view needs an explanation of how dynamic capabilities develop and adapt. Especially in frequently changing environments, even dynamic capabilities can become worthless, which is why organizations may need to modify or reinvent their dynamic capabilities. The question of how this is done, however, has remained largely unanswered.

This article advances one approach to addressing this question by developing and exploring the concept of second-order dynamic capabilities—“learning-to-learn” routines—that aim at reconfiguring the firm’s first-order dynamic capabilities. The concept of second-order dynamic capabilities is to the dynamic capabilities view what (first-order) dynamic capabilities are to the resource-based view and, thus, has the potential to significantly improve our understanding of strategic change. From a theoretical perspective, it allows dynamic capabilities theory to respond to the question of where (first-order) dynamic capabilities come from, with an answer that is consistent with the theory’s core assumptions and that leverages some of its key concepts (most notably, organizational routines). At the same time, it raises new questions about how complex dynamic capabilities theory needs to be to provide a realistic yet parsimonious model of competitive advantage. From an empirical perspective, second-order dynamic capabilities open up an important new agenda for empirical studies.

The main contribution of the current article is to bring greater clarity to the concept of second-order dynamic capabilities. This article not only highlights the role of learning-to-learn routines as an important type of second-order dynamic capabilities, but also theorizes on how these second-order dynamic capabilities influence performance outcomes. Taken together, this should reduce ambiguity about what second-order dynamic capabilities are and how they matter.

In addition to providing these theoretical insights, this article also makes empirical contribu-

tions by operationalizing second-order dynamic capabilities and providing novel evidence on how they relate to first-order dynamic capabilities and performance. I present empirical support for the notion that second-order dynamic capabilities impact performance for the most part through their effect on first-order dynamic capabilities. Finally, I find that first- and second-order dynamic capabilities can act as substitutes in affecting performance. I hope the ideas and findings discussed in this article will prove useful in future theoretical and empirical work on this exciting topic.

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