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COMPLEMENTS OR SUBSTITUTES? A MICROFOUNDATIONS PERSPECTIVE ON THE INTERPLAY BETWEEN DRIVERS OF AMBIDEXTERITY IN SMES

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ABSTRACT

Research on the microfoundations of ambidexterity has identified a number of drivers that shape the ability of individuals to overcome exploration-exploitation tensions. However, little is known about how these drivers interact and whether they act as complements or substitutes. In a two-stage survey of small and medium-sized enterprises, we find that formal structural drivers and informal contextual drivers of ambidexterity do not demonstrate complementarity, as generally assumed, but rather act at cross-purposes with each other. Furthermore, we find that behaviorally complex executives (those with the ability to think and act ambidextrously) appear to render the effects of the other two drivers relatively unimportant, and are only ever associated with moderate levels of ambidexterity. These findings permit the development of important theoretical insights for ambidexterity research from a microfoundations perspective.

Keywords: Ambidexterity, microfoundations, organization structure, organizational context, contextual ambidexterity, behavioral complexity, leadership ambidexterity.

INTRODUCTION

Ambidexterity literature has flourished in the past decade, and one important area of focus has been to understand the different ways firms manage the tensions between exploration and exploitation (Raisch et al., 2009). However, while we know a great deal about the separate effects of drivers of ambidexterity, we do not have a good understanding of how they might work together.

The conventional view has been that the drivers of ambidexterity are complements, i.e. they work better when used in combination. As Raisch and Birkinshaw (2008: 399) observe, "an in-depth analysis of these [prior] studies reveals complementarities between the different paths to ambidexterity." A few studies examining multiple drivers have suggested reinforcing effects, for example, between leadership and cultural antecedents (Nemanich and Vera, 2009; Havermans et al., 2015), between structural and contextual antecedents (Aoki and Wilhelm, 2017), or between leadership and structural antecedents (Cao et al., 2010). However, such studies have typically focused on a maximum of two categories of ambidexterity drivers.

Complements or Substitutes?

In this study, we adopt a microfoundations perspective (Felin, Foss, and Ployhart, 2015; Felin & Foss, 2005) to put forward an alternative point of view. Microfoundations research encourages us to look beyond the influence of single drivers on ambidexterity to how multiple, enmeshed lower level drivers, such as "actors, processes and/or structures" (Felin et al, 2012: 1353), jointly shape the actions of employees, which then aggregate to ambidexterity as a higher-level phenomenon. Building upon this perspective, we argue that it is necessary to look simultaneously at all three commonly identified drivers of ambidexterity (i.e., structural, contextual and leadership drivers; Raisch and Birkinshaw, 2008). These, we posit, often end up at cross-purposes with one another. This is because these drivers place the onus for managing exploration exploitation tensions on different sets of actors, embody fundamentally different mechanisms, and operate with different time lags between cause and effect. As a result, well-intentioned and ostensibly compatible efforts interact, in practice, in unpredictable and often damaging ways (Ennen and Richter, 2010; Senge, 1990).

Our focus in this study is on ambidexterity within a single organizational unit, or what Simsek et al (2009) call *harmonic ambidexterity*. This term refers to the 'locus' of ambidexterity (where and when it is observed), and it is distinguished from Simsek et al's (2009) other forms of ambidexterity by (a) occurring within a single unit rather than by balancing across units, and (b) occurring at a single point in time rather than by cycling back and forth over time.[1] Empirically, we chose small and medium-sized enterprises (SMEs) as our research context, where harmonic ambidexterity is particularly prominent. (Lubatkin et al., 2006; Simsek et al., 2009).

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[1] While other forms of ambidexterity, such as contextual ambidexterity (Gibson and Birkinshaw, 2004), have a similar intra-domain and temporal simultaneity orientation, 'harmonic ambidexterity' as a construct benefits from not confounding a specific ambidexterity driver (i.e., informal context) with its potential outcome (i.e., simultaneous, intra-unit exploration and exploitation). This compatibility with multiple potential drivers of ambidexterity is more closely aligned with our microfoundations perspective, and thus we rely on the more general notion of harmonic ambidexterity here.

Complements or Substitutes?

Drawing on prior ambidexterity literature (e.g., the review by Raisch and Birkinshaw, 2008), we identified three sets of drivers of harmonic ambidexterity: a) leadership capabilities (of an individual or a team) that allow decision makers to resolve strategic contradictions (e.g., Carmeli and Halevi, 2009: Jansen et al., 2016); b) informal contexts or cultures that enable employees to divide their time appropriately between two sets of activities (e.g., Gibson and Birkinshaw, 2004); and c) formal structures that provide the simultaneity of freedom and constraint conducive to the co-existence of two sets of activities (e.g. Andriopoulos and Lewis, 2009; Chang and Hughes, 2012; Jansen et al., 2006). These drivers do not, however, operate in discrete ways; instead, employees are exposed simultaneously to influences from all three. To paint a fuller picture of the microfoundations of ambidexterity, the manner in which these drivers function together needs to be understood. We argue that each driver — separately — is likely to have a positive association with ambidexterity, but that when used in combination they will create dissonance and misalignment of effort, resulting in a less positive overall outcome.

We tested our arguments in a two-stage survey of 88 SMEs in Germany. We found, as predicted, that the three sets of drivers (leadership capabilities, informal contexts, and formal structures) were, independently, significant predictors of harmonic ambidexterity, but that, in combination, they were associated with reduced levels of ambidexterity. The highest levels of ambidexterity were observed in firms rated high on either structural or contextual drivers of ambidexterity but low on the other two drivers. In contrast, for those firms rated high on leadership drivers, only moderate levels of ambidexterity were achieved, with the influence of structural and contextual drivers largely being nullified. Thus, while formal structures and informal contexts exhibited a high degree of substitutability in our SME context, there was only partial substitutability by leadership drivers in relation to the other two drivers.

Based on these findings, we make several contributions to advancing a fuller and more nuanced understanding of the microfoundations of ambidexterity. We respond, in particular, to

calls in the microfoundations movement to give more attention to "clearly understanding matters of aggregation and emergence, and how the organizational context shapes behavior" (Felin et al., 2015: 609). Prior research has tended to focus on only one or a maximum of two drivers of ambidexterity — or, at a lower level of regress, on one or two drivers of exploration and exploitation (Mom et al., 2018). This is the first empirical study, to our knowledge, to empirically examine the interplay between leadership behavior, and informal (cultural) and formal (structural) dimensions of organizational context in engendering harmonic ambidexterity. It is also, more importantly, the first to our knowledge to argue for (and find) substitutive relationships between multiple drivers of ambidexterity. The resulting, more complex picture of (at least partially) competing pathways to ambidexterity indicates that behaviorally complex top managers limit the effect of the informal or formal organization context on harmonic ambidexterity. Furthermore, as informal and formal contextual drivers of ambidexterity are shown to conflict in practice, powerful actors need to decide where best to focus their limited resources in order to enhance levels of harmonic ambidexterity.

THEORY AND HYPOTHESES

When addressing the question of what drives harmonic ambidexterity, scholars have proposed specific leadership capabilities, informal contexts, and formal structures (Chang and Hughes, 2012). We first consider these drivers individually. As the first two categories of drivers (leadership and informal context) have been extensively investigated in relation to harmonic ambidexterity, we theorize their (individual) impact only briefly, and primarily for the sake of consistency with foregoing research. Research on structural antecedents to harmonic ambidexterity is, however, more limited. We extend prior work by developing the new construct of *'compensatory structuring'* (which results from an inconsistent configuration of centralization and formalization) as a formal structural driver of harmonic ambidexterity.

<center>Complements or Substitutes?</center>

Having addressed each of these drivers one at a time, we then turn to how they might interact with one another. We do this by adopting a microfoundations perspective, which means, in essence, seeking to understand "how actors, their interactions, and the mechanisms and context that influence such interactions, produce firm-level and collective heterogeneity" (Felin et al., 2015: 605). Microfoundations "are not a theory, per se, but rather a movement and way of thinking that has spread across a broad array of macro theories" (Felin et al., 2015: 577). For understanding the microfoundations of ambidexterity, this perspective usefully puts the spotlight on key actors (including the cognitive and behavioral capabilities of senior executives; Eisenhardt et al., 2010), on the organizational context (both internal structures and processes; Felin et al., 2012, 2015; Teece, 2007), and on interactions between these.

Ambidextrous Leadership Capabilities: Behavioral Complexity of the CEO

Leadership research has long promoted the idea that managers should have "the ability to hold two opposing ideas in mind at the same time and still be capable to retain the ability to function" (Carmeli and Halevi, 2009: 209, quoting the writer F. Scott Fitzgerald). In line with this idea, scholars largely agree that effective senior executives should possess the cognitive capabilities to handle paradox, contradiction, and complexity in their environment (Denison et al., 1995; Lewis et al., 2002). Furthermore, Denison and colleagues (1995) argue that such cognitive capabilities should be extended to include behavioral capabilities: Leaders should not only be able to comprehend multiple ambiguous and contradictory forces, including the simultaneous presence of opposites, but also to formulate an adequate response comprising multiple, at times opposing, leadership roles and behaviors (Cameron et al., 2006).

Along these lines, Lewis and colleagues (2002), for example, find that successful product development requires managers to reconcile the tension between innovation and efficiency by exhibiting a blend of different, to some degree opposing, management styles. Similarly, Jansen

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and colleagues (2009) found that managers who combine both transformational and transactional leadership styles may be better able to balance exploration and exploitation. Research by Mom and colleagues (2007, 2009, 2015) on managers across multiple organizational levels supports this paradoxical view of "ambidextrous managers" as undertaking complex cognitive processing and being "skilled and motivated to engage in a wide repertoire of different or even opposing activities and roles" (2015: S135). In addition, at the team level, Carmeli and Halevi (2009) argue that a behaviorally complex top management team (which combines the collaborate, control, create, and compete behavioral categories; Denison et al., 1995) is more likely to make balanced strategic decisions, as they are better able to conceive and act on the paradoxes and contradictions inherent in the exploration-exploitation tension.

In larger organizations, business unit or area heads typically play influential roles in driving harmonic ambidexterity (e.g., Mom et al., 2007), while in SMEs this critical role is typically played by the CEO and his or her team (e.g., Lubatkin et al., 2006). Given that we chose SMEs as our empirical context, we focus here on the behavioral complexity of the CEO and hypothesize in line with prior research:

H1: The more behaviorally complex the CEO (in terms of her or his ability to combine collaborate, create, compete, and control roles), the higher the level of harmonic ambidexterity.

Ambidextrous Informal Context

The informal organizational context encompasses the shared systems, processes, and belief systems of actors that shape the day-to-day behaviors of employees (Gulati and Puranam, 2009). As a key element of the 'unique context' influencing how micro actions aggregate in organizations (Felin et al., 2015: 599), it is crucial to understand the role of informal context in

the emergence and persistence of harmonic ambidexterity. In ambidexterity research, the most widely followed approach to informal context is Ghoshal and Bartlett's (1994) conceptualization of context as the behavior framing attributes of discipline, stretch, support, and trust. In particular, Gibson and Birkinshaw (2004) argued that a context combining these attributes - which they term a "supportive" organization context - allows business units to integrate simultaneously strong performance management (i.e., "hard" elements of context, concerned with managing the delivery of demanding objectives) and social (i.e., "soft" elements of context, concerned with providing employees with the security and latitude they need to perform) orientations. This, in turn, enables and encourages employees to reach their own judgments about how best to divide their time between exploration-oriented and exploitation-oriented activities.

Gibson and Birkinshaw (2004) showed that such a context was associated with higher levels of ambidexterity, and over the years a number of other studies have broadly corroborated this finding (e.g., McCarthy and Gordon, 2011; Wang and Rafiq, 2014). For example, Khazanchi and colleagues (2007) found that a culture of flexibility promoted creativity and thus adaptability, while norms around control helped with execution and alignment. These in turn then allowed exploration and exploitation, respectively, to transpire.

Across these various studies, the notion of an informal behavior-framing context is typically operationalized at the level of an operating unit, say a business unit, a factory or a sales office, rather than the (large) firm or organization as a whole. This makes sense because the operating unit is typically the entity to which individual employees relate on a day-to-day basis, and its managers are the people from whom employees take their cues. This is compatible with our empirical SME focus, and we accordingly follow Gibson and Birkinshaw (2004) in arguing that the ability to establish an informal organizational context, which combines performance management and social support, fosters ambidexterity:

H2: The more that the informal organizational context is 'supportive' (i.e., characterized by an interaction of performance management and social support), the higher the level of harmonic ambidexterity.

Ambidextrous Formal Structure: Compensatory Structuring

From a micro-foundational perspective, "structures, whether at the organizational level or within an organization, specify the conditions that enable and constrain individual and collective action and establish the context for interactions within an organization" (Felin et al., 2012: 1364). While "structural ambidexterity" (i.e., the separation of exploration and exploitation into only loosely coupled organizational domains; Raisch and Tushman, 2016; Tushman and O'Reilly, 1996) might be a viable option in large firms, it contradicts the basic concept of harmonic ambidexterity, whereby exploration and exploitation are pursued in the same organizational domain (Simsek et al., 2009).

Most research on structural antecedents within a single organizational unit has focused on their separate effects on exploration or exploitation (c.f. Mom et al., 2018, for a parallel observation concerning prior research on the influence of human resource management practices on exploration and exploitation), but not on their impact on ambidexterity - as the simultaneous pursuit of exploration and exploitation. In two pertinent studies, for example, Jansen and colleagues (2006) and Prajogo and McDermott (2014) both found formalization to be positively associated with exploitative innovation, while centralization demonstrated a negative relationship to exploratory innovation. The former study was conducted within business units and the latter in SMEs.

In order to theorize the structural microfoundations of harmonic ambidexterity in SMEs, we turn to fundamental organization design principles (Bunderson and Boumgarden, 2010; Sine

et al., 2006). It seems logical that neither a purely organic (decentralized and non-formalized) nor a purely mechanistic (centralized and formalized) formal structure would be appropriate. Instead, a structural configuration different from either of these archetypes would appear to be necessary to foster exploration and exploitation simultaneously. Accordingly, configurational research (Olson et al., 2005; Vorhies and Morgan, 2003) has suggested that structures combining unorthodox composites of centralization and formalization might facilitate the achievement of more complex strategic objectives. We refer to such combinations as *"compensatory structures"* as one dimension compensates for the shortcoming of the other and vice versa. For example, in decentralized structures with high levels of formalization, decentralization might allow for quick, innovative, customer-oriented decisions to be taken by employees without double-checking with their superiors (i.e., exploration), while formalized policies and rules might ensure that the front-line also acts in accordance with the firm's prior experiences and best-practices (i.e., exploitation) (Olson et al., 2005). Alternatively, in a highly centralized, low formality setting, high levels of centralization may help align the entire firm around its current product-market strategies (i.e., exploitation), while a less formalized approach to policies and regulations still provides sufficient leeway for employees to explore new ways of achieving their strategic objectives (i.e., exploration).

To illustrate this logic, consider the example of a firm in the medical devices industry from our research. It was facing a multitude of legal requirements and had no choice but to establish a highly formalized process to meet these requirements. At the same time, its charismatic owner-manager took decisions in a highly centralized manner. Employees complained continuously about the limited room for entrepreneurial activity in the firm, in particular in respect of using their existing strengths to develop new business opportunities (i.e., to exploit and explore). When the owner stepped back from the operational management of the firm and appointed a new CEO, the latter decided to keep the high levels of formalization

demanded by the regulatory environment, but granted teams and their managers more decision making authority (i.e., decentralization). From that moment onward, the firm began to renew its competence base and found new ways of using its core competences, for example by entering an entirely new disease category with its products (i.e., to explore and exploit).

Accordingly, we posit that centralization and formalization demonstrate compensatory fit (Gulati and Puranam, 2009) in respect of ambidexterity: they motivate divergent but jointly valuable employee behaviors, making up for each other's shortcomings. While "achieving supplementary fit relies on one element augmenting the other by pushing in the same direction, … compensatory fit relies on one element pushing in a different direction in order to make up for the weakness of the other" (Gulati and Puranam, 2009: 423). These compensatory structural configurations can be expected to present their own challenges, and to necessitate careful design, implementation, and ongoing management. However, we would nonetheless expect such structures to have a positive effect overall on the level of harmonic ambidexterity.

H3: The more compensatory the formal structure (in terms of combining high levels of centralization and low levels of formalization or vice versa), the higher the level of harmonic ambidexterity.

The Interplay between the three Drivers of Ambidexterity

While individual drivers of ambidexterity have received substantial research attention, there has been limited analysis of how they might work together (Raisch and Birkinshaw, 2008). To make progress on this issue, which is fundamentally about how various antecedent conditions (i.e., actors, processes and structures) shape the actions of individuals, a micro-foundational perspective is useful and appropriate. As argued by Felin et al (2012: 1357), "action occurs within the social structure of an organization."

Complements or Substitutes?

To the extent that this interplay between drivers is discussed in the literature, individual antecedents are typically viewed as complements to one another. Multiple authors have speculated on equifinality across, and the potential for mutual reinforcement between, different pathways to ambidexterity (Andriopoulos and Lewis, 2009). By way of illustration, Gibson and Birkinshaw (2004: 221) explicitly introduced contextual ambidexterity as complementary to structural ambidexterity at the firm level, while Smith and Tushman (2005) have described behavioral complexity as a leadership process that would enable structural ambidexterity (rather than act as a substitute). Encapsulating the received wisdom in ambidexterity literature, Kauppila (2010: 284) argued that, "In reality, firms are likely to create ambidexterity through a combination of structural and contextual antecedents and at both organizational and inter-organizational levels, rather than through any single organizational or inter-organizational antecedent alone".

Our intention in this paper is to develop an alternative logic, to explain why ambidexterity drivers in our empirical context are at least partial substitutes. Before getting into our theoretical argument, it is useful to start with an anecdote drawn from an interview conducted by one of the researchers.

The company was a mid-sized publisher, and we interviewed a mid-level manager who was seeking to realign people in her team towards new digital channels, such as e-books and video content. She was doing this informally, by encouraging individuals to take responsibility and to experiment with their own ideas. This bottom-up change process was already underway when the CEO (i.e. the mid-level manager's boss) became aware that the company was not well-positioned in the emerging digital channels. The CEO acted decisively and, unaware of the mid-level manager's ongoing efforts, he provided additional funding to support digital products and he authorized a few specific people to work on them.

Complements or Substitutes?

For individuals on the front line, this new directive was confusing and somewhat demoralizing, because it undermined their earlier efforts, and they did not know whether to prioritize the requests of the mid-level manager they reported to or those of their ultimate boss, the CEO. While these mixed-messages were eventually resolved, and a mix between traditional and digital products achieved, there was a considerable amount of wasted energy along the way. One key individual also left the company during this period because of their frustration with the change process.

Why in this case would the two drivers of change (direct action by the CEO and a context-based effort by a mid-level manager) work at cross-purposes with one another, when there might be other situations where such efforts are complementary? We suggest that a key factor is the number of goals being addressed. When addressing a unitary goal, it is relatively easy to align top-down directives with the formal and informal processes that are designed to steer individual action. Well-known examples are the 'bundles' of compatible organizational practices that are used to improve quality and efficiency in automobile plants (MacDuffie, 1995) and in steel production (Ichniowski et al, 1997). In such cases, there are complementarities between activities (Milgrom and Roberts, 1995), so that doing more of one of them increases the return to doing more of another. For example, if the CEO of an automotive manufacturer makes 'quality' their personal priority, they are complementing ongoing investments in front-line training and quality circles, because the objective is unitary and explicit.

In contrast, when an organization is seeking to address two goals simultaneously (i.e. to become ambidextrous), the complementarity between activities is likely to be lost. Instead, there is a risk that different 'drivers' of ambidexterity will be used in ways that create confusion among those on the front line, because they shape action in different ways, and with different

time horizons. These mechanisms may therefore end up as substitutes not complements, as we saw in the publishing company anecdote above.

Consider first how the three drivers of harmonic ambidexterity shape individual action. Leadership drivers refer to the behavioral complexity of CEOs and their capacity to achieve a balance between exploitation and exploration directly through their own actions (Carmeli and Halevi, 2009; Jansen et al, 2008). In such circumstances, individuals operating on the front line have their actions shaped through direct top-down authority. This cause-effect mechanism is likely to be particularly salient in the SME context, where the CEO has a more direct line of sight and influence than in a larger corporation.

In contrast, contextual drivers shape the actions of front-line employees in an informal way, with individuals taking cues from those around them, and ultimately making personal choices about how best to divide their time between exploration and exploitation (Gibson and Birkinshaw, 2004).

Finally, structural drivers shape the actions of employees by defining their scope of responsibility, their reporting lines, and their incentive mechanisms. A structural approach to harmonic ambidexterity (unlike structural separation into explorative and exploitative units) allows mid-level managers to take responsibility for exploration-exploitation tensions, because they are the ones who are best positioned to take decisions based on formal rules and processes (Jansen et al, 2006) and to configure their part of the organization within these boundary conditions (Zimmermann et al., 2018). Recently, for example, Mom and colleagues (2018) provide evidence that firm-level formal rules (e.g., HR practices) influence the ability of operational (i.e., mid-level) managers to contribute to ambidexterity.

In sum, these three drivers of ambidexterity give responsibility for managing the exploration-exploitation tension to different levels in the organization, respectively the CEO (for leadership drivers), front-line employees (for contextual drivers) and mid-level managers

(for structural drivers). We can anticipate that these individuals, even if their overall interest in reconciling exploitation and exploration is the same, will often differ in their immediate priorities, because of their different position in the organization. Zimmermann and colleagues (2015), for example, showed how exploration and/or exploitation charters diverge across hierarchical levels and only gradually converge over time.

As a second line of argument, it is important to consider the time lag between stimulus and response for each of the three drivers. Leadership-based drivers of ambidexterity can operate very rapidly, especially in an SME context where the CEO has a direct line of sight to most activities. For example, the decision to cancel a project or make a new investment will often be implemented within days or weeks. In contrast, contextual drivers operate relatively slowly, because they require individuals to make sense of and internalize the expectations being placed on them before changing their behavior. Stated slightly differently, the informal organization has a higher level of inertia than the formal one (Boumgarden et al, 2012; Gulati and Puranam, 2009), so changing it takes considerable time and effort. Finally, in terms of structural drivers, it is possible to change formal structures very quickly, but there is typically a time lag before those changes work their way through to meaningful changes in individual behavior (Gulati and Puranam, 2009).

In sum, we can expect the time lag between cause and effect to be different for these three drivers, respectively fast (for leadership), slow (for context) and intermediate (for structure). These differences are likely to lead to unpredictable and potentially damaging effects on outcomes. By way of analogy, the well-known "beer game" (Senge, 1990) involves well-intentioned actors in a supply chain creating massive order backlogs or excessive inventory levels, in large part because of different time lags between cause and effect at different steps in the chain. This is one example of the broader notion of the firm as a complex system where the

parts interact in non-linear ways and with unpredictable consequences (Holland, 1992; Kaufmann, 1993).

Taken together, these features of our research phenomenon suggest a different 'interaction effect' (or 'non-linear aggregation' of micro actions; Felin et al., 2015: 591) between organizational practices to what would usually be predicted in the organization design literature, which commonly emphasizes the synergistic potential of such practices. As argued by Ennen and Richter (2010), heterogeneous elements (e.g., policies, structures, practices and resources) will often deliver synergistic or complementary effects in pursuit of a specific outcome, but when these elements rely on fundamentally different modes of organizing, their combination is likely to be subject to negative marginal returns – i.e., they will act as substitutes for each other. For example, research by Grandori and Furnari (2008) suggests that combining, at high levels, practices with different types of organizing principles is associated with lower levels of performance. They infer that "If in low doses different elements complement each other, at higher doses there are reasons to hypothesize that they may entail negative complementarities" as peoples' energy, cognitive capacity and behavioral flexibility is limited (Grandori and Furnari, 2008: 469-470). Given the expertise and resource scarcity challenges that plague small firms' efforts towards ambidexterity (Ebben and Johnson, 2005; Voss and Voss, 2013), we expect that negative marginal returns to pursuing multiple routes to ambidexterity would be particularly pronounced in SMEs.

In summary, we propose that, rather than acting in a mutually reinforcing manner, efforts to pursue drivers of harmonic ambidexterity in combination are likely to prove counterproductive. At high levels, contradictions between the drivers will likely be magnified, creating confusion and cognitive and behavioral overload for employees. The three drivers are therefore likely to act as substitutes, reducing or nullifying each other's impact:

H4: The three drivers of harmonic ambidexterity (behavioral complexity of the CEO, organizational context, and compensatory formal structure) act as substitutes for one another: the combined effect of two or more will be lower than the effect of a single driver.

RESEARCH METHODS

Our hypotheses are contingent on the boundary condition that ambidexterity is sought within a single organizational unit, and not achieved through the structural differentiation of explorative and exploitative units (i.e., what Tushman and O'Reilly, 1996, call structural ambidexterity). As prior research suggests, this holds for SMEs, which face competitive pressure to integrate exploration and exploitation (Simsek et al., 2009), while they lack the resources and systems to accommodate multiple organizational units with distinct objectives (Lubatkin et al., 2006; Bierly and Daly, 2007).

We followed a two-step process. In the first round of data collection in 2012, we collected survey data on our independent variables (i.e., leadership, contextual, and structural drivers of ambidexterity as well as the control variables). As ambidexterity typically only unfolds over time, and in order to mitigate common method bias (Podsakoff and colleagues, 2003, 2012), we collected data on the dependent variable in a second survey in 2014.

Sample

To identify the SMEs for our sample, we used the Hoppenstedt (today Bisnode) firm database, as the largest provider of SME contact details in Germany, and defined SMEs as firms with 500 or fewer employees (Arend, 2006; Lu and Beamish, 2001; Lubatkin et al., 2006). We identified and contacted 1,079 manufacturing SMEs across Germany. We sent the CEO of each SME an email, which included a cover letter explaining our research project and a questionnaire measuring the independent variables. Consistent with the guidance of Chang and colleagues

(2010) on mitigating common method bias, we emphasized that all responses would be treated confidentially and anonymously, and that there were no right or wrong answers. In addition, participants were informed that they would be offered a summary report at the conclusion of the project.

We received a total of 190 questionnaires (18%), which compares well with similar studies in the field (Sidhu et al., 2007; Simsek et al., 2007). We tested for potential non-response bias by examining the differences between the respondents and non-respondents with regard to firm size and industrial sector, using t- and chi-squared tests respectively ($t = -1.021$, $p = 0.308$; $\chi2 = 28.328$, $df = 22$, $p = 0.165$), but found no indication of such bias. In addition, we used t-tests to investigate potential differences between the late and early respondents for all of the model variables. We did not find signs of late-response bias (t-values ranged from -1.195 to 0.285), strengthening our confidence that non-response bias does not pose a significant concern in our study (Armstrong and Overton, 1977).

Prior studies have suggested that CEOs of SMEs play both strategic and day-to-day operational roles in their organizations and can thus be considered knowledgeable regarding their organizations' structures, as well as their explorative and exploitative activities (Bierly and Daly, 2007; Cegarra-Navarro and Dewhurst, 2007; Simsek et al., 2007). As an additional reliability check, however, some studies have surveyed a second respondent (e.g., subordinates or operational-level managers) per firm to rule out single-informant bias (Venkatraman and Grant, 1986). Accordingly, we asked the CEO of each SME to nominate a second respondent, to whom we sent an identical questionnaire. We obtained additional questionnaires from 55 SMEs. We used these additional responses to calculate the inter-rater agreement with regard to all of the model variables (r_{wg}; James et al., 1993). The average inter-rater agreement was well above the threshold value of 0.6 (Glick, 1985) for all the model variables, with r_{wg} values

ranging between 0.70 and 0.81. We therefore felt confident using the responses of the primary respondents, i.e. the SMEs' CEOs, for the subsequent hypothesis testing.

For the second round survey, we contacted the 190 CEOs who had responded to the first survey with a follow-up questionnaire examining the dependent variables. We received valid questionnaires from 88 CEOs (response rate 46%). This constitutes the sample on which we conduct our analyses. We tested once again for potential non-response bias by examining the differences between the respondents and non-respondents to the second round of data collection. Using t- and chi-squared tests, respectively, we found no indication of such bias in respect to firm size or industrial sector (t = 0.913, p = 0.363; $\chi2$ = 25.914, df = 21, p = 0.210). In addition, we tested for differences between the late and early respondents for the model variables derived from this round of data collection. Using chi-squared tests, we again did not find signs of late-response bias (*Exploitation*: $\chi2$ = -0.265, df = 53, p = 0.792; *Exploration*: $\chi2$ = -0.944, df = 53, p = 0.349), strengthening our confidence that non-response bias does not pose a significant concern in our study.

While we cannot completely rule out the possibility of common method variance, we are confident that, given the steps we took to mitigate this bias (including, our two-stage data collection process and validation of CEO responses against those of second informants), along with our complex specification of relationships among the independent and dependent variables (Siemsen et al., 2010), it is unlikely to be a critical limitation with the current data and to confound the interpretation of results.

Measures

We relied on multi-item, established scales for each of our core constructs, using seven-point Likert-style response formats ranging from "I totally disagree" to "I totally agree" except where

otherwise indicated. Consistent with recommended psychometric practice (e.g., Furr, 2011), we retained the full original set of items for all multi-item measures.

The survey was administered in German after following forward- and back-translation procedures. Prior to administration, we subjected the design of the questionnaire to two rounds of pre-testing, with: (a) six scholars who were familiar with the topic and had a good understanding of the underlying theory; and (b) six CEOs of German SMEs (not included in the final sample), who were asked to comment on its structure, clarity, and design. Based on the predominantly positive feedback received, only a handful of minor adjustments were made to ensure its ready comprehension by respondents.

Dependent variable. To measure *Harmonic Ambidexterity*, we relied on the established two-step approach suggested by prior research and employed separate scales for exploration and exploitation (e.g., Gibson and Birkinshaw, 2004; Jansen et al., 2012; Jansen et al., 2008). We utilized Lubatkin and colleagues' (2006) scales, which each consist of six items for explorative or exploitative orientation. These reported adequate reliabilities: exploration scale ($\alpha = 0.86$) and exploitation scale ($\alpha = 0.76$). In addition, via CFA, a comparison of a one-factor model with a two-factor model showed a significant improvement in fit ($\Delta\chi2$ significant at $p < .001$) providing evidence of discriminant validity between the measures for explorative and exploitative orientation.

In a second step, assuming that exploration and exploitation are non-substitutable and interdependent, we then followed the dominant approach taken in previous research and combined the scales into a single measure for ambidexterity by means of multiplication (Birkinshaw and Gupta, 2013; Gibson and Birkinshaw, 2004; Jansen et al., 2008, 2012). We report the findings of post hoc tests using alternative computations of harmonic ambidexterity in the "Further Analysis" section below.

Independent variables. *Behavioral Complexity of the CEO* was operationalized using Lawrence and colleagues' (2009) 36-item behavioral complexity instrument, an extension and revision of the original 16-item measure developed by Denison and colleagues (1995). Each behavioral category (collaborate, control, create, and compete) was measured with a nine-item scale. The reliability scores of the four scales were high (between 0.81 and 0.85), comparing well with Lawrence and colleagues' (2009) results. To arrive at a score for behavioral complexity, we took the grand mean of respondents' mean scores across the four behavioral categories. While measures of ambidextrous leadership tend to examine the extent to which managers engage in exploratory and exploitative activities over a defined period (e.g., Mom et al., 2007, 2009, 2015), our investigation into the microfoundations of firm-level ambidexterity is more compatible with the focus on leaders' "cognitive and behavioral capacity to recognize and react to paradox, contradiction, and complexity in their environments" (Denison et al., 1995: 525).

Organizational Context was measured using Gibson and Birkinshaw's (2004) scale for organization context, which sought to represent the dimensions of discipline, stretch, support, and trust identified by Ghoshal and Bartlett (1994) as critical parameters of the informal organizational context. The measure consists of two multi-item scales: a seven-item scale ($\alpha = 0.61$) for the performance management context and a nine-item scale ($\alpha = 0.82$) for the social context. These were combined by means of multiplication, as the performance and social dimensions of organizational context need to be considered holistically and are non-substitutable (Gibson and Birkinshaw, 2004).

Compensatory Formal Structure examined the extent to which each firm exhibited compensatory mismatches between its levels of centralization and formalization. Centralization and formalization were based on Jansen and colleagues' (2006) five-item scales. Centralization measured the extent to which decision making authority is controlled at the center (rather than

distributed across the organization) and formalization, the extent to which written rules and policies guide tasks and activities. The reliabilities were good for both scales (centralization, α = 0.86; formalization, α = 0.79).

To arrive at a measure for compensatory formal structure, we calculated the absolute difference between the centralization and formalization scores (cf. Bobko and Schwartz, 1984). As compensatory structuring by definition reflects the degree of inconsistency in organizational structuring, lower values indicate greater consistency between the degree of centralization and formalization within an organization, whereas higher values reflect more inconsistent scores on these two structuring dimensions.

Control variables. These were informed by prior literature and measured in the first round of data collection. As task environment has been found to influence the ratio of explorative to exploitative activities undertaken by firms, we controlled for industrial sector (Lavie et al., 2010; Simsek et al., 2009) and environmental dynamism (Jansen et al., 2008, 2012; Lubatkin et al., 2006). *Industrial Sector* was measured via dummy variables (denoting automotive, chemical, electronics, pharmaceutical, machinery, food, fashion and primary extractive sectors). Based on the insights of Jansen and colleagues' (2009), we controlled for *Environmental Dynamism* via two items examining the strength and frequency of changes experienced by the firms in their business environments. We further controlled for *Family Ownership* as family firms have been found to make different strategic choices from non-family owned firms, for example in respect of investment in innovation (Gomez-Mejia and Cruz, 2011). A dummy variable measured responses to a single-item, namely: "Would you regard your firm as a family business (more than 50% in the hand of not more than two families and family members in management positions)?" (0 = no; 1 = yes). We also accounted for a firm's age, size and its levels of prior performance as these have been related to inertia, flexibility and resource availability (Jansen et al., 2006, 2012; Lubatkin et al., 2006). *Firm Age* and *Firm Size*

were measured in terms of years since founding and number of employees (logged). *Prior Performance* consisted of two items asking respondents to compare their return on sales and profit margin with those of their major competitors over the previous two years (1 = much worse, 7 = much better). Furthermore, senior executives' experience could play an important role in dealing with complexity in the environment (Jansen et al., 2008; Mom et al., 2009). We therefore controlled for the most senior executive's (i.e., the CEO's) *Age*, *Tenure in Firm*, and *Tenure in Job* (all in years) to capture their level of experience. Another determinant of an executive's capabilities is her or his education; consequently, we controlled for level of *Education* (Mom et al., 2009).

RESULTS

Table 1 presents the means, standard deviations, and zero-order correlations for all variables. Uncentered means are shown in the correlation matrix, although we standardized the variables for hypothesis testing to aid in the interpretation of the posited interaction effect (Dawson, 2014). Of note, while *Behavioural Complexity of the CEO* and *Organizational Context* exhibit strongly positive bivariate correlations with *Harmonic Ambidexterity* (r = 0.57 and r = 0.47, respectively, *p* = .000), *Compensatory Formal Structure* does not (r = -0.03, *p* = 0.758).

Insert Table 1 about here

We tested our hypotheses using robust regression (the robreg procedure in Stata 13.0; Jann, 2010) which performs an iterated procedure to generate ordinary least squares (OLS) estimates robust to the presence of outliers (Cook, 1977; Verardi and Croux, 2009). Table 2 reports the results of this analysis.

Complements or Substitutes?

Model 1 includes only control variables. Models 2, 3 and 4 add in main effects for *Behavioral Complexity of the CEO*, *Organizational Context*, and *Compensatory Formal Structure*, respectively. H1 to H3, predicting positive main effects on harmonic ambidexterity are all supported. The coefficient estimates for *Behavioural Complexity of the CEO* ($\beta = 5.70$, SE = 0.66, p = 0.000, CI [4.41; 6.99][2]; Model 2), for *Organizational Context* ($\beta = 4.46$, SE = 0.74, p = 0.000, CI [3.01; 5.91]; Model 3), and for *Compensatory Formal Structure* ($\beta = 1.70$, SE = 0.59, $p = 0.004$, CI [0.54; 2.86]; Model 4) on ambidexterity are all positive and significant. Model 5 incorporates all three drivers as predictors of harmonic ambidexterity: the coefficients demonstrate a consistent pattern of findings to those demonstrated in Models 2 to 4.

Insert Table 2 about here

Finally, in Model 6, we test for H4, for which we find support. As expected, the interaction term between the three drivers on harmonic ambidexterity ($\beta = 127.01$, SE = 19.54, p = 0.000, CI [88.70; 165.31]) is significant. In addition, the inclusion of this three-way interaction term (and its associated lower order interaction terms) results in a sizeable improvement in R^2 over those of Models 2 to 5 (ΔR^2s ranging between 0.07 and 0.20).

Plotting this three-way interaction graphically facilitates further insight into the conditional effects of firms utilising multiple drivers to foster harmonic ambidexterity. Figure 1 displays these relationships, representing each of the three variables at one standard deviation from its mean (Aiken and West, 1991; Jaccard and Turrisi, 2003). It is evident that the lowest levels of ambidexterity are associated with firms employing low levels of all three drivers. Moreover, as expected, the highest levels of ambidexterity were not associated with high scores

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[2] We report 95 percent confidence intervals (CIs) throughout this paper.

on all three. Instead, ambidexterity was maximized where firms specialise in employing just one driver. The pattern of relationships between the drivers of harmonic ambidexterity is thus one of substitution where "the marginal benefit of each activity [driver] decreases in the level of the other activity [driver]" (Siggelkow, 2002: 901),

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Insert Figure 1 about here

Post hoc simple slope and slope difference tests were used to probe these findings further (Dawson, 2014). In combination with the patterns shown in Figure 1, we can draw more specific inferences regarding the extent to which the three drivers function as substitutes for one another. The biggest substitution effect is between *Organizational Context* and *Compensatory Formal Structure*: the highest levels of ambidexterity are achieved when one or the other of these two drivers (on its own) is strongly present. This effect is particularly pronounced in the instance of a supportive organizational context and low levels of inconsistent formal structuring. However, when these drivers are pursued at high levels together, the resultant level of ambidexterity is significantly lower.

In contrast, high *Behavioural Complexity of the CEO* is only ever associated with moderate levels of harmonic ambidexterity, and it displays more limited substitution effects with the other two drivers. Simple slope and slope difference tests suggest that where an SME has a strongly behaviorally complex CEO, the extent to which formal structures are compensatory or to which the organization context is supportive, makes little difference to harmonic ambidexterity.

Our results are therefore consistent with our theory, but with the important proviso that the problem of people acting at cross-purposes arises most notably where structural and contextual drivers of ambidexterity are used together. Furthermore, the findings in respect of

CEOs' degree of behavioural complexity are somewhat more complex than anticipated, suggesting a distinctive role for this driver: High levels of CEO behavioral complexity appear to dampen the effects of the other drivers, such that harmonic ambidexterity is always circumscribed in the presence of a behaviorally complex senior leader (i.e., high levels of CEO behavioral complexity act as only partial substitutes for the structural and contextual drivers of ambidexterity).

Further analysis

In order to further strengthen inferences regarding causality from our study, we followed the principles set out by Granger (1980, 2001) and tested whether our hypothesized findings held up once a measure for *Harmonic Ambidexterity* (collected in 2012 during the first round, and employing identical items to those used in 2014) was included in our regression equations. All the hypothesized findings were confirmed in this analysis (including, the *3-way interaction term*: $\beta = 98.73$ SE $= 18.52$, p $= 0.000$, CI [62.44; 135.02]), indicating that the three drivers that we examined interacted in a manner consistent with our propositions once historical levels of (multiplicative) ambidexterity in the firm were taken into account.

We also conducted additional analyses to further probe our findings in respect of an association between compensatory structure and harmonic ambidexterity. In our main analyses reported above, we followed the guidance of Edwards (2001) against, when using a difference measure, including the component terms thereof as controls. Nonetheless, we ran subsequent separate tests of the effects of the individual components of the compensatory structuring measure (i.e., formalization and centralization) on harmonic ambidexterity: both coefficients were negative and significant ($\beta = -1.25$, SE $= 0.50$, p $= 0.012$, CI [-2.23; -0.27] for *Formalization*, and $\beta = -1.91$, SE $= 0.41$, p $= 0.000$, CI [-2.72; -1.11] for *Centralization*). We also, using the raw rather than absolute difference between these component measures, ran

regressions to examine whether the effect of compensatory structuring on ambidexterity was consistent, irrespective of the direction of the difference between these measures. Significant coefficients for the main (β = -6.54, SE = 0.83, p = 0.000, CI [-8.17; -4.91]) and squared (β = 7.40, SE = 0.82, p = 0.000, CI [5.80; 8.99]) terms of the (raw) difference between *Formalization* and *Centralization* confirmed this effect. In other words, no matter whether formalization or centralization was higher within a specific SME, the greater the difference between these measures, the higher the level of harmonic ambidexterity.

We also tested the sensitivity of our analyses to alternative operationalizations of ambidexterity (refer to Table 3). Specifically, we compared the findings using our multiplicative ambidexterity measure against measures reflecting balance and additive (He and Wong, 2004; Lubatkin et al., 2006) conceptions of ambidexterity. The *Ambidexterity (Balance)* measure comprised of the absolute difference between the exploration and exploitation scores for each firm. We reversed the final scores for the balance measure to aid interpretation (i.e., low values indicate lower levels of balance between exploration and exploitation, and vice versa). The *Ambidexterity (Additive)* measure summed the exploration and exploitation scores for each firm. Overall, employing these alternative measures for ambidexterity resulted in largely consistent findings to those attained with the multiplicative operationalization of ambidexterity. The relationships between the three drivers, and balance and additive ambidexterity, are depicted graphically in Figures 2a and 2b.

Insert Table 3 about here

Insert Figures 2a and 2b about here

Finally, we examined the association between ambidexterity and firm performance in our sample. The performance implications of harmonic ambidexterity have been accorded considerable attention in the ambidexterity literature to date (Junni et al., 2013). Accordingly, although ambidexterity is the dependent variable in our research, it is appropriate to consider the extent to which ambidexterity is associated with firm performance. We measured *Performance* in the second round of data collection using an identical measure to that of *Prior Performance,* i.e. two items examining respondents' perceptions of their firm's sales and profitability margin relative to those of their major competitors.

Insert Table 4 about here

As shown in Table 4, all three operationalizations of ambidexterity are positively and significantly associated with firm performance (multiplicative ambidexterity: $\beta = 0.71$, SE = 0.26, p = 0.007, CI [0.19; 1.20]; additive ambidexterity: $\beta = 0.08$, SE = 0.03, p = 0.002, CI [0.03; 0.13]; and balance ambidexterity (reversed): $\beta = 0.47$, SE = 0.10, p = 0.000, CI [0.27; 0.66]). We acknowledge that these analyses may suffer from common-method bias, but we report them here for the sake of comparison with extant research.

DISCUSSION

The purpose of this study was to shed light on how three different drivers of harmonic ambidexterity (i.e., behavioral complexity of the CEO, supportive informal context, and compensatory formal structure) interact when used jointly. While each had a positive effect in isolation, and firms rated low on all three exhibited the lowest levels of ambidexterity, structural and contextual drivers of ambidexterity seemed, in particular, to act at cross-purposes with one

another when employed in combination. As a result, firms rating high on both drivers demonstrated lower levels of ambidexterity than those emphasizing just one.

Our study therefore contributes to the most important challenge in ambidexterity research, namely *how* firms can reconcile the partially-contradictory need for exploration and exploitation at the same time (Gupta et al., 2006). While the literature on ambidexterity has flourished over the past decade, it has also become increasingly fragmented (Birkinshaw and Gupta, 2013). Accordingly, scholars have called for more integrative research on how the different drivers of ambidexterity work together. Raisch and Birkinshaw (2008: 399), for example, state that "future research could formally develop and test propositions on how different antecedents interact and complement one another in a firm's pursuit of organizational ambidexterity." Similarly, Hill and Birkinshaw (2014: 24) encourage future research "to elucidate the conditions under which relational, behavioral, and structural mechanisms work alone or together to foster unit-level ambidexterity". To our knowledge there has been little empirical research following these calls. Moreover, where authors have reflected upon the nature of relationships between the drivers of ambidexterity (e.g., Gibson and Birkinshaw, 2004, O'Reilly and Tushman, 2013), the common assumption is that "they are not in conflict but rather are complementary" (Aoki and Wilhelm, 2017: 1082) and can be used in combination. The current study shows that, at least within our empirical setting, this assumption is not true – the drivers we examined are, to a large degree, substitutes not complements.

This study thus speaks to matters of fundamental importance to scholars taking a micro-foundations perspective on ambidexterity. A central interest of prominent exponents of the microfoundations movement in strategy and organization theory is how "the interactions of individuals, processes, and structures … contribute to the aggregation and emergence of the collective constructs" (Felin et al., 2012: 1353). The microfoundational emphasis on "interaction within context" (Felin et al., 2015: 603-4) recognizes that "(E)ach category [of

constituent components, i.e., individuals, processes and structures] does not operate in a vacuum. Instead, they are enmeshed in different interactions within an organization (individuals and individuals, individuals and processes, etc.)" (Felin et al., 2012: 1357).

By asking how multiple, widely recognized drivers of ambidexterity interact when considered in combination (as they actually occur in organizations), we endeavor to get to the heart of the hitherto neglected topic of how the microfoundations of ambidexterity aggregate. We will now discuss three important contributions of our study towards advancing a fuller, more nuanced understanding of the microfoundations of ambidexterity.

First, our results suggest the value of selecting a specific driver of harmonic ambidexterity. If all mechanisms were complementary, firms could strive to develop several ambidexterity drivers without having to choose one or the other. Instead, we observe that the drivers of ambidexterity exhibit strongly non-linear forms of aggregation (Barney & Felin, 2013). This suggests that decision makers need to make a choice, and, in particular, to choose between structural and contextual approaches. This raises the question: does the concept of equifinality apply, allowing firms to make a free choice between equally effective alternatives? While the relatively similar effects of structural and contextual drivers on ambidexterity would support the equifinality assumption, we still expect there might be contingencies that need to be taken into account when choosing the most appropriate driver. Recent research suggests, for example, that a firm's organizational heritage (Birkinshaw et al., 2016), the technology characteristics of its sector (Fourné et al., 2019), or the nature of its transformational challenges (Zimmermann and Birkinshaw, 2016) might be potential contingency factors in deciding between structural and contextual options. Our post-hoc analysis using alternative operationalizations of ambidexterity might provide hints regarding additional contingency factors. If firms strive to balance exploration and exploitation (instead of aiming to maximize both), the contextual driver appears to be superior to all other options. While there is relatively

little research on the circumstances under which one or another ambidexterity strategy is more applicable (Gupta et al., 2006; Cao et al., 2009; Wilden et al., 2018), future studies investigating this discrepancy could aid our understanding of conditions (both internal and external to the firm) influencing the relative efficacy of different drivers.

Second, our study provides novel insights into the role of senior executives in fostering ambidexterity. In particular, we raise questions regarding the efficacy of behaviorally complex executives relative to drivers of ambidexterity embedded in the formal and informal organization. In so doing, we take steps towards building a much fuller, more nuanced picture of how interactions between influential actors and organizational contexts aggregate (or, perhaps more accurately, "detract from one another") within the microfoundations of ambidexterity literature. While the role of individual actors in the emergence of collective phenomena has long been a focus of microfoundations research, "one pillar of microfoundations is the explicit recognition of contextual factors, though this type of work certainly remains at its infancy" (Felin et al., 2015: 602). Moreover, these authors (p. 603) argue: "In all, context should not just be the background of microfoundations research, context should also be put to the foreground."

Prior research has emphasized the direct actions of executives as enablers of ambidexterity (e.g., Heavey et al., 2015; Lubatkin et al., 2006; Mihalache et al., 2014; Mom et al., 2007, 2018). While we found positive effects of CEO behavioral complexity in our study, these were limited in magnitude relative to those of compensatory structuring and a supportive behavioral context. Given our empirical context of SMEs, where literature suggests that CEOs fulfill both strategic and day-to-day operational roles and should thus be particularly impactful in driving ambidexterity, this finding is particularly surprising. A possible explanation might be that simultaneously performing a broad variety of leadership roles (e.g., collaborate, create, compete, and control roles) may not only overburden the individual leader, but also the

organization as a whole. Accordingly, if multiple leadership roles are important, leaders might be required to emphasize only one at any given point, and to switch between roles over time (Junni et al., 2015).

Besides their limited impact when employed in isolation, our findings also suggest that high levels of CEO behavioral complexity limit the effects of ambidextrous formal structures or supportive informal organizational contexts. Unlike prior research, which emphasized the enabling role of top managers' leadership qualities in engendering structural and contextual ambidexterity (e.g., Carmeli and Halevi, 2009; Gibson and Birkinshaw, 2004, Smith and Tushman, 2005), this finding suggests that the development and maintenance of such structures and contexts should be decoupled from the cognitive and behavioral abilities of the CEO. Unless future research jointly examines individual and contextual drivers - and seriously entertains the possibility that these might constrain rather than reinforce each other - a misleading impression of the roles of leadership, climatic and structural antecedents will continue to proliferate in literature on the microfoundations of ambidexterity.

Third, our insights add an interesting nuance to the literature on the interplay between formal and informal drivers of ambidexterity. Currently, two perspectives prevail on this topic: Firstly, structural ambidexterity research suggests that exploration and exploitation be pursued in separate domains (i.e., within structurally separate organizational units). Within each organizational domain, formal and informal organizational contexts should be aligned to mutually reinforce each other in order to foster either exploration or exploitation - and to enable ambidexterity at an overarching organizational level (O'Reilly and Tushman, 2008). Secondly, in contrast, research on temporal forms of ambidexterity finds that, when formal structures shift from exploration-orientation to exploitation-orientation (or vice versa), the informal social context tends to lag behind, such that the disjunction between the two fosters ambidexterity (Boumgarden et al, 2012; Gulati and Puranam, 2009). We put forward a third alternative,

namely: formal and informal contexts might interfere with each other where both seek to enable ambidexterity within a single organizational unit. These contexts might be complementary and mutually reinforcing as long as they are, individually, oriented towards either exploration or exploitation. However, in the more complex case of harmonic ambidexterity, if both formal and informal contexts are geared towards enabling exploration and exploitation *simultaneously*, conflicting forces appear to dominate.

Finally, beyond our focus on ambidexterity research, we also contribute insights to the related body of literature on paradox in organizations (Schad et al., 2016). Prior organizational paradox research suggests that organizations face multiple tensions that necessitate multi-pronged management approaches (Smith and Lewis, 2011). Based on qualitative case studies, Andriopoulos and Lewis (2009) suggest that such different management approaches may form virtuous cycles by mutually reinforcing each other. However, the same authors also state that "given the need to manage such complexity in consistent yet paradoxical ways, it is not surprising that ambidexterity remains a much lauded, but rarely achieved, organizational capability" (Andriopoulos and Lewis, 2009: 708). Our findings provide support for this latter statement, showing that, on average, multiple different approaches to deal with exploration-exploitation tensions tend to act at cross-purposes with each other. Given these divergent findings, we strongly encourage future research to shed light on possible boundary conditions influencing whether paradoxical management approaches act in concert or interfere with each other, and what factors might enable organizations to successfully combine multiple approaches (that are in themselves paradoxical) to manage paradoxical tensions.

Furthermore, paradox research classically distinguishes between constructive and destructive individual responses to paradoxical challenges (Schad et al., 2016). Specific abilities or cultural backgrounds have been identified as affecting whether individuals embrace (and even thrive) in situations of paradox, or whether they succumb to negative reactions such

as anxiety, uncertainty, and ambiguity. Our study questions the black and white nature of this distinction as we show that, if pursued in concert, multiple "constructive" approaches to creating and sustaining ambidexterity might result in negative outcomes.

Practical Implications

The fact that the different drivers of ambidexterity seem to work at cross-purposes to one another creates an interesting managerial challenge. It suggests that it is not appropriate for managers to spread their efforts across multiple potential pathways to ambidexterity. Instead, in organizations where more than one driver of ambidexterity is already well developed, the managerial challenge would be a completely different one, namely: to limit the ambidextrous capacity of the superfluous driver(s). Such an intentional loss (or unlearning) of competences has been described as a major challenge in prior research and requires distinct knowledge management processes (De Holan et al., 2004; Klammer and Gueldenberg, 2018). We thus encourage executives to develop systematic practices to assess, track and to strategically shape - whether through learning or unlearning processes - multiple potential drivers of ambidexterity in order to improve their firms' overall ambidextrous capabilities.

Limitations and future research

Our study is naturally not without limitations. One particular boundary condition is that we focus on harmonic ambidexterity, where exploration and exploitation are pursued within the same organizational unit at the same point in time. Recent conceptual work has suggested that this form of ambidexterity is particularly effective for firms striving for continuous improvement and ongoing renewal, which were also of prime relevance for the firms in our sample. However, other challenges, such as cross-functional linking or reconfiguring of activities might be more effectively met by other forms of ambidexterity such as structural

separation or temporal cycling (Zimmermann and Birkinshaw, 2016). We would thus encourage future research to investigate to what extent the substitution effects we observe also apply under different boundary conditions.

Furthermore, our study relies on three widely used categories (and specific, associated conceptualizations) of ambidexterity drivers (e.g., Raisch and Birkinshaw, 2008). We do not, however, assume that this set of drivers represents either a comprehensive or immutable inventory of antecedents of ambidexterity. We thus see ample opportunity for future research to study the complementary or substitutive nature of alternative sets of drivers.

Per recent ambidexterity research (Mom et al., 2015, 2018), it would also be interesting to apply multi-level research designs and modelling techniques to investigate the interplay of drivers of harmonic ambidexterity across hierarchical levels. In addition, we see room for qualitative, case-based research to analyze the multi-level tensions and sources of inefficiencies between interacting drivers. As we argued earlier, the drivers that we investigate principally reside at different levels within an organization (e.g., behavioral complexity at the top management level, compensatory formal structuring at the team level, and an ambidextrous informal context at the individual level), but the design of our study regrettably does not permit us to empirically link the drivers to these levels and to directly test the multi-level effects we posit. Further investigation of potential multi-level effects amongst ambidexterity drivers thus presents an opportunity to shed more light on how ambidexterity transpires across an organization's hierarchy.

Furthermore, our data stems from German firms and our findings are potentially contingent on the particularities of this national context. While most studies on the role of context have focused on the influence of the industry environment on ambidexterity's performance effects (Jansen et al., 2006), recent research has shown that national contexts may have a strong impact on firms' ability to engage in exploration and exploitation (Khan, Rao-

Nicholson, & Tarba, 2018). The relatively high levels of family firm ownership and the tendency towards higher levels of formalization may be particularities of the German context. While we have included or controlled for these particularities in our models and they did not seem to have altered our results, we encourage future research to study how internal and external contingencies and boundary conditions affect the interplay amongst the microfoundations of ambidexterity.

Finally, although we employed a two-phase research design in order to strengthen our ability to draw inferences regarding the relationships of interest, longitudinal research that can more rigorously examine temporal dynamics – and, in particular, the effects of different sequencing of drivers – informing the interplay amongst ambidexterity drivers, and their implications, would be beneficial. Recent research has also advocated a dynamic perspective on ambidexterity (Luger et al., 2018; Walrave et al., 2017; Wilden et al., 2018) arguing that, in the long run, firms may need to adjust the balance between exploration and exploitation over time. Our insights into the drivers of ambidexterity may inform future research on how such adjustments might be made - for example, by switching between different drivers of ambidexterity over time.

CONCLUSION

The purpose of our study was to gain a better understanding of the interplay of multiple drivers of harmonic ambidexterity. Our data suggests that, instead of reinforcing each other, behaviorally complex leaders and enablers of ambidexterity embedded in organizations might conflict, limiting each other's effectiveness. Accordingly, our study suggests that decision makers, should they wish their organizations to become ambidextrous, might need to select one dominant mechanism and focus their resources and attention on developing the capabilities underlying that mechanism. This is good news for all those practitioners who feel overburdened

by the broad variety of scholarly recommendations, as our findings raise the possibility that less is more when it comes to achieving ambidexterity. In addition, given that our findings go contrary to widely held assumptions amongst ambidexterity scholars, we hope that our study encourages more probing debate and research into the interplay amongst drivers of ambidexterity and their boundary conditions. Understanding the microfoundations of ambidexterity is, this study suggests, a more complex endeavor even than hitherto recognized by scholars of organizations.

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Table 1: Descriptive statistics and correlations

	Variable`	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.	*Harmonic Ambidexterity*																				
2.	*CEO behavioral complexity*	0.57																			
3.	*Organizational context*	0.47	0.58																		
4.	*Compensatory formal structure*	-0.03	0.01	0.14																	
5.	*Environmental dynamism*	0.17	0.31	0.06	0.04																
6.	*Family ownership*[a]	0.04	-0.07	-0.02	-0.09	-0.19															
7.	*Firm age*	0.13	0.15	0.04	-0.02	-0.08	0.26														
8.	*Prior firm performance*	0.28	0.44	0.38	0.09	0.21	-0.09	-0.07													
9.	*Firm size*	0.09	-0.03	0.00	-0.07	0.03	0.15	0.28	-0.06												
10.	*CEO tenure in firm*[b]	0.20	0.33	0.31	0.16	0.00	0.12	0.16	0.18	0.09											
11.	*CEO tenure in job*[c]	0.13	0.35	0.34	0.09	0.08	0.11	0.06	0.16	0.03	0.79										
12.	*CEO education*[d]	0.01	0.06	-0.01	-0.27	0.05	0.04	0.00	-0.03	-0.03	-0.23	-0.13									
13.	*CEO age*[e]	0.08	0.28	0.17	0.02	0.24	-0.21	-0.02	0.00	0.04	0.51	0.52	0.00								
14.	*Automotive sector*[f]	-0.01	-0.03	0.01	-0.07	-0.15	0.08	-0.11	-0.18	-0.07	-0.05	-0.04	-0.01	-0.07							
15.	*Chemicals sector*[g]	-0.20	0.03	-0.10	-0.02	0.10	0.00	-0.00	0.05	-0.03	0.02	0.03	0.19	0.02	-0.04						
16.	*Electronics sector*[h]	-0.08	-0.01	0.05	0.04	-0.05	0.01	-0.16	0.09	-0.11	-0.10	-0.08	-0.20	-0.07	-0.07	-0.21					
17.	*Fashion sector*[i]	-0.03	-0.09	0.04	-0.21	-0.09	0.04	0.14	-0.00	-0.08	-0.10	-0.17	0.06	-0.07	-0.02	-0.07	-0.14				
18.	*Food sector*[j]	0.00	0.07	-0.02	0.21	-0.02	-0.15	.08	-0.04	-0.09	-0.05	-0.04	-0.08	-0.04	-0.03	-0.10	-0.19	-0.06			
19.	*Machinery sector*[k]	0.15	0.11	0.13	-0.06	0.03	-0.23	-.080	0.04	0.11	0.07	0.07	0.00	0.11	-0.05	-0.17	-0.31	-0.11	-0.14		
20.	*Pharmaceutical sector*[l]	-0.11	-0.206	-0.16	-0.14	-0.11	0.08	-.100	-0.23	-0.13	-0.07	-0.03	0.15	0.14	-0.01	-0.04	-0.07	-0.02	-0.03	-0.05	
	Mean[m]	30.31	5.42	24.31	1.72	5.21	0.66	41.76	5.13	159.19	14.71	9.94	3.06	50.48	0.01-	0.10-	0.28	0.05	0.08	0.19-	0.01-
	S.D.	9.04	0.61	6.90	1.17	1.24	-	32.32	1.00	113.96	11.08	7.88	0.70	7.49	-	-	-	-	-	-	-
	Min	3.69	3.06	9.43	0.00	2.00	-	2.00	2.00	13.00	1.00	1.00	1.00	34.00	-	-	-	-	-	-	-
	Max	46.67	6.56	42.86	5.80	7.00	-	130	7.00	500.00	48.00	38.00	4.00	68.00	-	-	-	-	-	-	-

Notes. N = 88 [a] Dummy variables (1 = family ownership). [b-e] Refer to the most senior executive in the firm. [f-l] Dummy variables; missing category refers to primary extractive sectors. [m] Mode indicated for categorical variables. Correlations greater than 0.21 are significant at $p < .05$ (two tailed); correlations greater than 0.28 are significant at $p < .01$ (two tailed).

Table 2: Results of robust regression analysis examining the effects of CEO behavioral complexity, organizational context, and compensatory formal structure, on harmonic ambidexterity

	Model 1			Model 4			Model 3			Model 2			Model 5			Model 6		
	Coef.	S.E.	p.	Coef.	S.E.	p.	Coef.	S.E.	p.	Coef.	S.E.	p.	Coef.	S.E.	p.	Coef.	S.E.	p.
Sector effects	Yes			Yes			Yes			Yes			Yes			Yes		
Environmental dynamism	1.65	(0.57)	0.004	1.54	(0.54)	0.004	2.74	(0.70)	0.000	0.63	(0.60)	0.297	-2.61	(0.45)	0.000	0.07	(0.36)	0.846
Family ownership	2.08	(1.21)	0.087	7.72	(1.12)	0.000	5.02	(1.49)	0.001	1.93	(1.28)	0.130	6.17	(0.91)	0.000	0.23	(0.74)	0.757
Firm age	-1.83	(0.65)	0.005	-1.17	(0.61)	0.057	-0.37	(0.79)	0.637	-1.16	(0.68)	0.088	-2.08	(0.50)	0.000	-0.57	(0.39)	0.147
Firm size (log)	-0.38	(0.62)	0.541	-0.60	(0.57)	0.295	2.31	(0.76)	0.002	0.03	(0.65)	0.965	3.32	(0.47)	0.000	1.27	(0.37)	0.001
Prior firm performance	-1.28	(0.54)	0.018	-3.83	(0.56)	0.000	-1.27	(0.70)	0.071	-0.92	(0.57)	0.107	-4.64	(0.46)	0.000	-1.87	(0.37)	0.000
Tenure in firm[a]	2.48	(0.82)	0.003	0.33	(0.76)	0.667	2.00	(1.01)	0.047	2.45	(0.87)	0.005	-0.52	(0.63)	0.405	-0.03	(0.50)	0.952
Tenure in job[b]	0.29	(0.73)	0.691	-0.16	(0.68)	0.812	-1.67	(0.91)	0.066	0.03	(0.77)	0.968	0.57	(0.56)	0.310	1.04	(0.47)	0.026
Education[c]	2.40	(0.59)	0.000	-2.14	(0.55)	0.000	0.16	(0.55)	0.826	2.56	(0.63)	0.000	0.09	(0.46)	0.851	1.20	(0.37)	0.001
Age[d]	-0.90	(0.63)	0.153	-0.27	(0.58)	0.641	1.23	(0.77)	0.111	-0.04	(0.67)	0.947	0.88	(0.47)	0.064	0.09	(0.38)	0.808
CEO behavioral complexity				5.70	(0.66)	0.000							9.18	(0.62)	0.000	22.86	(2.83)	0.000
Organizational context							4.46	(0.74)	0.000				1.74	(0.52)	0.001	75.85	(8.61)	0.000
Compensatory formal structure										1.70	(0.59)	0.004	2.70	(0.44)	0.000	61.84	(12.31)	0.000
CEO behavioral complexity X compensatory formal structure																-43.33	(12.72)	0.001
Organizational context X compensatory formal structure																-145.39	(18.82)	0.000
CEO behavioral complexity X organizational context																-78.37	(9.85)	0.000
CEO behavioral complexity X organizational context X compensatory formal structure																127.01	(19.54)	0.000
$R^{2\,e}$	0.23			0.26			0.25			0.25			0.36			0.43		

Notes.

N = 88.

[a-d] Refer to the most senior executive in the firm.

[e] Robust R^2 (rho).

DV = multiplicative interaction of exploration and exploitation. Two-tailed tests. Constant omitted. Unstandardized coefficients shown. Standard errors in parentheses..

06Table 3: Results of robust regression analysis on alternative measures of harmonic ambidexterity

	DV = Harmonic Ambidexterity (Additive)								DV = Harmonic Ambidexterity (Balance) [a]							
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**		**Model 6**		**Model 7**		**Model 8**	
	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.
CEO behavioral complexity	0.80 (0.12)	0.000					7.24 (0.55)	0.000	0.31 (0.03)	0.000					0.74 (0.19)	0.000
Organizational context			0.68 (0.13)	0.000			21.07 (1.67)	0.000			0.23 (0.03)	0.000			1.85 (0.58)	0.001
Compensatory formal structure					0.32 (0.11)	0.003	21.33 (2.39)	0.000					-0.10 (.03)	0.000	1.38 (0.83)	0.097
CEO behavioral complexity X compensatory formal structure							-19.16 (2.47)	0.000							-1.29 (0.86)	0.135
Organizational context X compensatory formal structure							-39.83 (3.66)	0.000							-2.31 (1.27)	0.069
CEO behavioral complexity X organizational context							-23.03 (1.91)	0.000							-1.91 (0.67)	0.004
CEO behavioral complexity X organizational context X Compensatory formal structure							38.19 (3.80)	0.000							2.21 (1.32)	0.095
$R^{2\ b}$	0.26		0.23		0.24		0.41		031		0.29		0.29		0.39	

Notes.
N = 88.
[a] Scores on the balance harmonic ambidexterity measure are reversed such that low values indicate lower levels of balance between exploration and exploitation, and vice versa.
[b] Robust R^2 (rho).
Two-tailed tests. Constant omitted. Unstandardized coefficients shown. All control variables included. Standard errors in parentheses..

Table 4: Results of robust regression analysis on firm performance

	DV =Performance							
	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.	Coef. (S.E.)	p.
Exploitation	0.21 (0.06)	0.001	-0.01 (0.12)	0.934			0.62 (0.06)	0.000
Exploration	-0.03 (0.06)	0.624	-0.61 (0.17)	0.001			-0.56 (0.08)	0.000
Ambidexterity (Multiplicative)			0.71 (0.26)	0.007				
Ambidexterity (Additive)[a]					0.08 (0.03)	0.002		
Ambidexterity (Balance)[b]							0.47 (0.10)	0.000
$R^{2\ c}$	0.38		0.38		0.35		0.38	

Notes.
N = 88.
[a] As the additive ambidexterity measure is a linear function of exploitation and exploration, these lower order variables are omitted from tests using the additive measure.
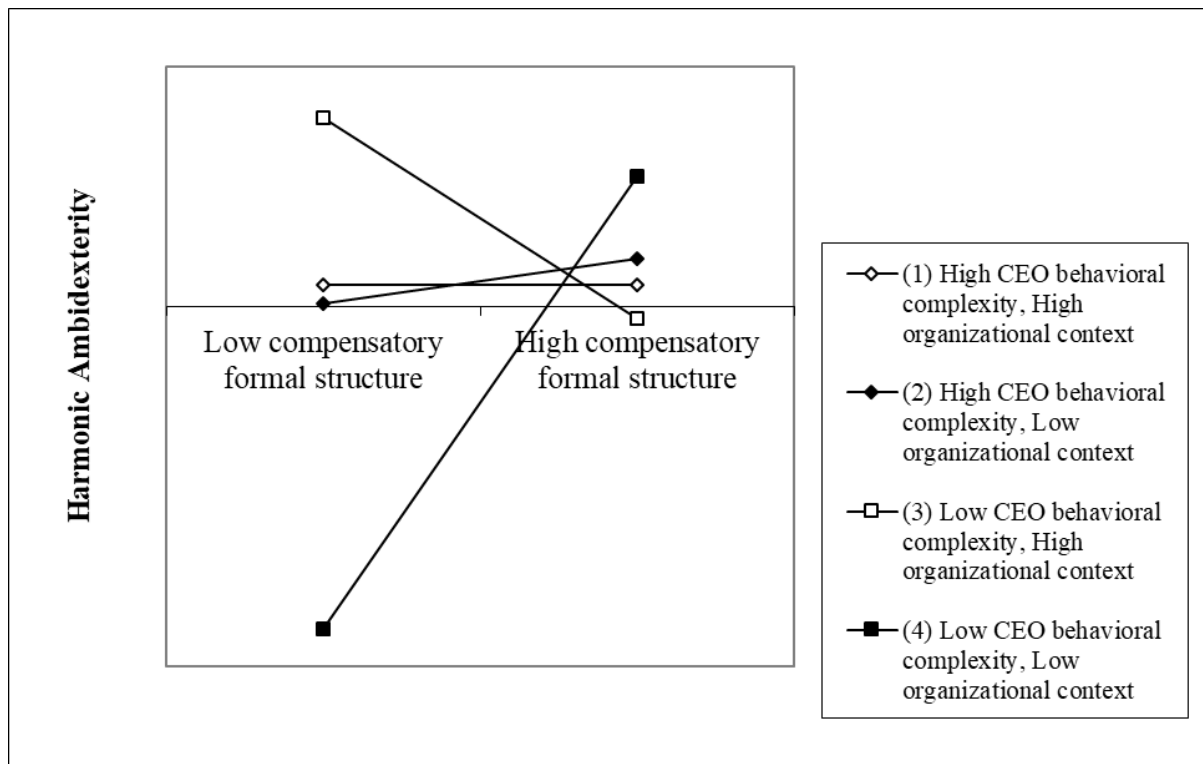[b] Scores on the balance ambidexterity measure are reversed such that low values indicate lower levels of balance between exploration and exploitation, and vice versa.
[c] Robust R^2 (rho).
Two-tailed tests. Constant omitted. Unstandardized coefficients shown. All control variables included. Standard errors in parentheses..

Complements or Substitutes?

Figure 1: Three-way interaction effect of CEO behavioral complexity, organizational context, and compensatory formal structure, on harmonic ambidexterity (multiplicative)

Figures 2a & 2b: Plots for additive harmonic ambidexterity and balance harmonic ambidexterity

2a.

2b.