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## The Role of Organizational Structure in Senior Managers' Selective Information Processing

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**ABSTRACT** CEOs' perceptions of the environment and the information processing shortcuts (or heuristics) they use to develop these perceptions are important to organizations. We study whether organizational structure, an important channel and filter for the flow of information in organizations, affects CEOs' perception gaps pertaining to the competitive environment. Perception gaps are defined as systematic deviations of subjective perceptions of the competitive environment from conceptions based on objective data. Studying 281 CEOs based in 216 firms, we find that functional structures are associated with wider environmental perception gaps, whereas divisional structures are associated with narrower gaps. To address endogeneity concerns, we control for firms' exposure to varied environments and only sample newly appointed CEOs, who, by definition, inherit predefined organizational structures exogenous to their own choices. Our study advances understanding of senior managers' information processing shortcuts by clarifying how organizational-level influences (i.e., organizational structure) affect CEOs' (mis)perceptions of the competitive environment.

**Keywords:** CEO bias, environmental uncertainty, heuristics, managerial perception, organizational structure, upper echelons

## INTRODUCTION

The competitive environment confronting any organization is one of several important determinants of its performance (e.g., Daniels et al., 1994; Hodgkinson and Johnson, 1994; Nadkarni and Narayanan, 2007; Zajac and Bazerman, 1991). However, understanding this environment is difficult and requires the processing of comprehensive information. For this reason, CEOs are constantly exposed to information overload (Graffin

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et al., 2011), which requires them to apply information processing shortcuts or heuristics (Simon, 1990) and different schools of thought have developed about the emergence and consequences of such behaviour. From one perspective, known as ‘the heuristics and biases program’, limitations emerge when information is processed automatically and effortlessly, which can lead to simplifying heuristics that function as a source of systematic errors in decision-making (e.g., Maule and Hodgkinson, 2002; Nadkarni and Barr, 2008; Schwenk, 1984). From an alternative perspective (e.g., Artinger et al., 2015; Bingham et al., 2019), heuristics are conscious, effortful reasoning skills that help to extract and select the most relevant information (Gigerenzer and Gaissmaier, 2011). Common to both of these schools of thought is a predominant focus on individual-level antecedents to explain the emergence of heuristics and biases (e.g., Chatterjee and Hambrick, 2011; Malmendier et al., 2011).

In the present paper, we theorize about an organizational-level antecedent to individual-level information processing shortcuts, namely, organizational structure. The structure of an organization serves as an important information channel or filter for its senior managers (e.g., Daniels et al., 1994; Foss and Weber, 2016; Sutcliffe, 1994). It affects the way in which they perceive information (e.g., Fjeldstad et al., 2012; Galbraith, 1973), by restricting their attention to only some of the information potentially available (e.g., Ocasio, 1997), and shaping how they interpret it (e.g., Foss and Weber, 2016; Sutcliffe, 1994).

Our aim is to understand how two prominent structural forms, functional and divisional<sup>[1]</sup> (Girod and Whittington, 2015), affect CEO bias. To this end, we investigate the extent to which and in what ways functional and divisional structures are associated with systematic variations in CEOs’ perception gaps. Given that divisional structures are implemented to mimic firms’ exposure to certain industries, products, or markets (Daft, 2015), we suggest that they channel and present information to CEOs in a manner coherent with their firms’ actual, objective environment and, accordingly, reduce their environmental perception gaps. Conversely, functional structures that focus on the efficient internal division of labour but not firms’ actual business environments (Daft, 2015) should increase such gaps.

Moreover, we suggest that individual-level differences influence the extent to which organization structure manifests in CEOs’ environmental perception gaps. Specifically, we argue that CEOs’ independent reasoning ability should diminish the effect of organization structure on their environmental perception gaps. This is because CEOs with greater (lesser) ability levels should be more (less) aware of information distortions induced by organizational structure, thus enabling them to rectify such distortions. We operationalize CEO independent reasoning ability by means of three proxy variables, respectively reflecting: (1) educational career, (2) career diversity, and (3) top management team (TMT) tenure.

We investigate the veracity of our thesis through an empirical study, spanning 13 years, based on a sample of 216 S&P500 companies and 281 CEOs. To limit endogeneity concerns, we only sample newly appointed CEOs, as they are exposed to predefined organizational structures exogenous to their own choices. Furthermore, we control for diversification to account for concerns that organizational structures may resemble firms’ exposure to different industries. Methodologically, to establish

comparability among the CEOs in our sample, we compare CEOs' personal environmental assessments (as voiced in their letters to shareholders) with Keats and Hitt's (1988) well-established accounting-based measure of the environment. We find support for our hypothesized baseline associations that CEOs operating variously in functionally and divisionally structured organizations respectively vary in the extent to which they exhibit greater and lesser environmental perception gaps. Furthermore, we find support for our hypothesis that CEOs' independent reasoning ability moderates the positive relationship between functionalization and CEO environmental perception gap. When comparing CEOs in organizations with a higher/lower degree of functional structure (mean  $\pm$  1 SD), the deviation in the perception gap increases by approximately 40 per cent of one standard deviation. Moreover, for firms with a higher degree of functional structure (mean + 1 SD), the effect decreases by 57 per cent points of one standard deviation when the CEO holds a master's degree rather than a bachelor's degree. Correspondingly, high/low career diversity and TMT tenure (mean  $\pm$  1 SD) result in a 45 per cent and 55 per cent points lower environmental perception gap, respectively.

Collectively, our findings are important because the environment in which firms compete is a key factor for the performance of firms. However, senior managers' perceptions of the environment vary (Daniels et al., 1994; Hodgkinson and Johnson, 1994) and firms' actions mostly depend on their senior managers' perceptions of the environment. Consequently, we need to understand the sources of systematic deviation between the two, as such sources are likely to cause a performance penalty for firms.

Our study of the role of organizational structure in CEO bias adds to previous studies that have predominately focused on individual-level specific sources of such bias (e.g., Das and Teng, 1999; Hodgkinson et al., 1999). We also contribute to upper echelons theory, which predominately assumes that organizations are reflections of their senior managers (Hambrick and Mason, 1984), whereas our results reveal an opposite effect, i.e., organizational structure channels senior managers' perceptions and judgements. Furthermore, we contribute to the perspective of behavioural strategy, which integrates behavioural and economic perspectives on executive judgement (e.g., Das and Teng, 1999; Hodgkinson and Healey, 2011; Levinthal, 2011). Our insights document that the quality of judgement is not only a function of (un)biased individuals but also of organizational-level influences, i.e., organizational structure. Finally, in terms of methodological contributions, we provide a longitudinal assessment of perceived environmental uncertainty (e.g., Duncan, 1972; Garg et al., 2003; Nadkarni and Barr, 2008).

## THEORETICAL FRAMEWORK AND HYPOTHESES

### Senior Managers' Heuristics and Biases

CEOs' use of information processing heuristics and the potential biases emerging from them (e.g., Das and Teng, 1999; Hodgkinson and Healey, 2008; Schwenk, 1988) have been widely studied and documented (e.g., Das and Teng, 1999; Hodgkinson

et al., 1999; Maule and Hodgkinson, 2002; Miller and Shapira, 2004). This stream of studies relies on the seminal work of Simon et al. (Newell and Simon, 1972; Simon, 1990), who suggest that given their information processing limitations, time constraints, and information asymmetries, human decision makers act as cognitive misers, who, in so doing, adopt cognitive shortcuts. Such cognitive shortcuts, which are often called ‘heuristics’, emphasize the selection of a subset of information rather than systematic and comprehensive information processing (e.g., Foss and Weber, 2016; Hodgkinson and Sadler-Smith, 2018). The managerial domain is particularly well suited to the study of heuristics because business environments are especially information- and noise-rich. Therefore, information overflow is highly relevant, and heuristics are required to construct simplified representations of the environment (Csaszar and Ostler, 2020; Nadkarni and Barr, 2008).

Different schools of thought have evolved within the literature on heuristics. From one perspective, known as ‘the heuristics and biases program’ (Kahneman and Klein, 2009; Tversky and Kahneman, 1974), scholars emphasize the negative consequences of heuristics (e.g., Das and Teng, 1999; Hodgkinson et al., 1999; Maule and Hodgkinson, 2002; Miller and Shapira, 2004; Schwenk, 1984, 1988). Central to this perspective is the argument that heuristics are processed using automatic (i.e., nonconscious) information processing strategies, known as Type 1 processes (Evans and Stanovich, 2013) that conserve scarce cognitive resources (see also Hodgkinson and Sadler-Smith, 2018). This view emphasizes selective information processing as a source of systematic errors or deviations from logic or statistics (Tversky and Kahneman, 1974).

A second perspective, known as the ‘fast and frugal heuristics’ perspective (Gigerenzer and Gaissmaier, 2011; Gigerenzer and Goldstein, 1996), highlights the benefits of ignoring information and emphasizes the conditions in which selective information processing provides more accurate outcomes when compared to more comprehensive processing (Gigerenzer and Brighton, 2009). In this view, heuristics are not the result of nonconscious processing, but rather of effortful and conscious reasoning skills (e.g., Artinger et al., 2015; Gigerenzer and Gaissmaier, 2011). The idea of conscious heuristics features in the study of simple rules’ usage in business and management (e.g., Bingham et al., 2019; Bingham and Eisenhardt, 2011). From this perspective, information selection (i.e., heuristics) is superior in high variance/noise decision-making situations, as noise is often mistaken as a signal or meaningful variance, which leads to overfitting (Artinger et al., 2015).

Previous work studying the sources of senior managers’ information processing shortcuts based on either of these schools of thought has predominantly concentrated on individual-level antecedents. For example, such studies have investigated CEOs’ private and professional experience (Bingham and Eisenhardt, 2011; Malmendier et al., 2011), personal traits (e.g., Chatterjee and Hambrick, 2011; Finkelstein et al., 2009), and mental representations (Csaszar and Levinthal, 2016). Departing from this work, the present study investigates organizational-level antecedents, to obtain an improved understanding of the emergence of senior managers’ information processing shortcuts.

## Heuristics and Organizational Context

Several conceptual arguments suggest that organizational-level influences have a bearing on senior managers' development and use of heuristics, not least the attention-based view, which highlights the role of organizations in channelling the scarce attentional resources of its decision makers (Ocasio, 1997), and the notion that organizations are noise-rich and socially complex entities that provide fertile ground for the development of heuristics (Csaszar and Ostler, 2020). Conversely, some scholars have expressed doubts as to 'whether biases will survive in an organizational arena that naturally includes a variety of checks and balances' (Staw, 2010, p. 413; see also Foss, 2003).

Although these arguments favour the influence of organizational structure on individuals' information processing, direct studies about this relationship are rare. Prior work addressing organizational-level influences on, or associations with, individual-level heuristics have focused on organizational routines and dynamic capabilities (Artinger et al., 2015; Hodgkinson and Healey, 2011; Teece, 2007) as well as on organizational learning (Bingham et al., 2019; Bingham and Eisenhardt, 2011). Scholars claim that these constructs explain how heuristics manifest in organizational decision-making processes (Bingham and Eisenhardt, 2011; Helfat and Peteraf, 2015).

In application to routines, as a multiagent phenomenon, routines are much more complex and rely on more comprehensive information processing than heuristics (Artinger et al., 2015). Routines evolve from a process that gives rise to context-dependent adaptive strategies that emerge in the search for the best action when no optimal solution can be inferred ex-ante. Interactions between individuals in an organization are central to routines, and they are associated with dynamic capabilities: the 'ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments' (Teece et al., 1997, p. 516). Cohen et al. (1996, p. 663) stress that routines are 'complex, highly automatic [...] behaviors that [...] typically involve high levels of information processing'.

From an organizational learning perspective, 'firms learn heuristics from repeated experience' (Bingham et al., 2019, p. 125) in a given environment. Viewed from this perspective, heuristics are an important underlying mechanism of organizational learning and describe the actual content of learning. They are the result of certain information processing shortcuts suited for a firm's specific environment. At an aggregated level, such firm-specific learning has recently been associated with a theory-based view, which views managers as theorists in organizations (Felin and Zenger, 2017). From this perspective, managers develop information processing shortcuts from their experience about which 'activities they should engage in, which assets they might buy, and how they will create value. A firm's strategy, then, represents a set of contrarian beliefs and a theory – a unique, firm-specific point of view – about what problems to solve, and how to organize and govern the overall process of value creation' (Felin and Zenger, 2017, p. 258).

The argument summarized above, together with evidence demonstrating how organizational-level factors manifest in individuals' heuristics (e.g., Barberà-Mariné et al., 2019), indicates the relevance of organizational-level mechanisms for managers' information



processing shortcuts. In the present study, we investigate one such organizational-level mechanism, organizational structure, in detail and attempt to understand how it affects information processing shortcuts at the senior management level.

The attention-based view (ABV) is an important theoretical perspective linking organizational structure to senior managers' information processing (Ocasio, 1997). According to the ABV, the way in which organizations distribute and channel the attention of their members ultimately focuses attention on particular elements of information (Ocasio, 1997, 2011). In other words, 'different hierarchical forms are associated with particular frames and social referents that naturally' influence individuals' information selection or attention (Foss and Weber, 2016, p. 61). In this context, 'attention' is defined as 'noticing, encoding, interpreting, and focusing of time and effort by organizational decision-makers [...] for making sense of the environment' (Ocasio, 1997, p. 189). In short, the distribution of attention creates the context and situation in which senior managers operate (Ocasio, 1997). Extant studies directly associate attention with managerial information processing (March and Simon, 1958; Simon, 1947). Organizations and the ways in which the division of labour shapes them channel the attention of their managers. Consequently, senior managers focus their attention on certain aspects of information while ignoring other aspects (Simon, 1947). In our context, variance in organizational structure should affect CEOs' assessment of environmental uncertainty. In formal terms:

*Baseline Hypothesis* Organization structure affects (i.e., variously increases and decreases) CEOs' environmental perception gaps.

### **Functional and Divisional Structure as Antecedents of CEOs' Environmental Perception Gaps**

To investigate whether organizational structure affects CEOs' environmental perception gaps, we rely on two prevalent forms of organizational structure: functional and divisional structure (e.g., Fjeldstad et al., 2012; Galbraith, 1973; Young et al., 2004). In organizations with a higher degree of functional structure, organizational activities are grouped to a greater extent on the basis of common functions (e.g., R&D, production, and marketing), whereas in organizations with a higher degree of divisional structure, the logic for grouping is typically based on output-oriented characteristics (e.g., industries, products, and/or markets). According to extant studies (e.g., Lawrence and Lorsch, 1967; Ocasio, 1997, 2011), both of these types of structural arrangements affect the manner in which managers gather and process information.

We claim that greater degrees of functional structure increase CEOs' environmental perceptions gap for two reasons. First, in functional structures, the main logic for the division of labour is to enable the efficient grouping and coordination of a firm's internal activities and operations (Galbraith, 1973; Lawrence and Lorsch, 1967). Although such structures allow for economies of scale (Fjeldstad et al., 2012), they are not designed or intended to accurately represent the environment. In other words, information processing in functional structures aims to increase operational efficiency rather than mirror environmental conditions. Similarly, functional structures are input-based, and they generally direct senior managers'

attention to matters internal to the firm (Charns and Tewksbury, 1993; Young et al., 2004). Overall, such structures are likely to generate an image of the environment influenced by input or efficiency logics, and this image is likely to deviate from an external, market-focused environmental assessment. By contrast, the logic underlying divisional structures mirrors the environment in which organizations operate (Young et al., 2004). With regard to the division of labour, these structures, which are also called business or product-line structures, typically follow industry, market, product, or service-related logics and, accordingly, more closely match organizations' actual business environments, as determined objectively (Young et al., 2004). These logics are output-oriented as they aim to closely mirror market conditions, identify changes in the environment, and provide the flexibility needed to adapt to external changes (Charns and Tewksbury, 1993). Consequently, such structures are likely to lead to an overlap between senior managers' perceptions of the environment and their assessment of the environment based on objective data.

Second, organizations with higher degrees of functional structure are more focused and specialized than organizations with greater degrees of divisional structure (Fjeldstad et al., 2012). In functional structures, senior managers create isolated pockets of attention on specific activities such as procurement, manufacturing, and marketing (Young et al., 2004). By contrast, divisional structures foster more comprehensive, multidimensional information processing; i.e., under these arrangements, decision makers consider broad sets of information pertaining to particular products, industries and/or services, which transcend functional boundaries. Although divisional structures tend to hamper efficiency in relation to a specific activity or function, they ensure that senior managers receive and attend to information that is more broadly based, thus enabling them to develop a more comprehensive understanding of the environment (Young et al., 2004). In short, the broader information processing promoted by divisional structures is likely to provide senior managers with a more complete understanding of their environment, thereby reducing CEOs' environmental perception gaps. Put formally:

*Hypothesis 1a:* The more organizational structure is function-oriented, the greater CEOs' environmental perception gaps.

*Hypothesis 1b:* The more organizational structure is division-oriented, the lower CEOs' environmental perception gaps.

### **Moderating Role of CEOs' Independent Reasoning Ability**

We argue that the information channelled through the organizational structure has not only an isolated effect on senior managers but also that this influence is contingent on individual-level information processing differences. This argument is associated with previous studies of heuristics and biases (e.g., Das and Teng, 1999; Maule and Hodgkinson, 2002) and upper echelons theory (e.g., Hambrick, 2007; Hambrick and Mason, 1984), which suggests that differences in individuals' perceptions arise mostly because of individual-level information processing differences (Eggers and Kaplan, 2013; Hodgkinson and Healey, 2008).

We suggest that CEOs' independent reasoning ability affects the extent to which information, channelled through their organizations' structures, manifests in their perceptions.



Arguments from several related bodies of work suggest that such ability may allow CEOs to recognize or correct structure-induced distortions.

First, the level of education affects individuals' independent reasoning ability, such that individuals who are better educated are able to challenge, reflect upon, and reframe incoming information (Pressley et al., 1989; Smith et al., 2005). Education shields individuals from interfering distractions (Pressley et al., 1989), enables them to adopt alternative perspectives on the same set of information (Papadakis et al., 1998), and enhances their knowledge base and independent reasoning skills (Smith et al., 2005). These mechanisms are particularly important moderators of the impact of organizational structure on the information processing of CEOs. In such situations, CEOs with stronger independent reasoning ability should be more aware of organizational structure-induced information distortions and be better able to rectify them.

Second, scholars studying career diversity provide further arguments suggesting that independent reasoning ability should moderate the impact of organization structure on the information processing of CEOs. In general, career diversity describes the accumulation of various types of managerial experience and is associated with the development of multifaceted diagnoses of and solutions to business problems (Dragoni et al., 2011). Career diversity thus provides the cognitive breadth necessary to adopt alternative perspectives on a given situation or information set (Crossland et al., 2014), not least because individuals with greater levels of such diversity are more likely to have seen similar business problems from different angles (Super, 1990), thereby enabling them to question more critically and hence realize when their information processing is being biased by the constraining effects of organizational structure.

Third, and finally, according to scholars studying CEOs' TMT experience, it is likely that longer-tenured CEOs are more likely to have worked in a wider variety of structural settings. In addition, they are more likely to have experienced various reorganizations (Kesner, 1988). Both of these types of experience should enable them to understand better the role of the organization's structure and isolate its impact on how they process information. Furthermore, long-tenured TMT members are more confident, willing to challenge current ways of thinking (Kosnik, 1990), and generally exhibit higher levels of cognitive complexity (Graf-Vlachy et al., 2020). They question the information provided (or framed) in certain ways; put more simply, they are more likely to challenge organizational structure-induced framing.

For all of the foregoing reasons, we predict:

*Hypothesis 2a/b:* CEO independent reasoning ability moderates the association between organizational structure (2a, functional; 2b, divisional) and CEOs' environmental perception gaps, such that the greater the ability level, the lower this association.

## METHOD

### Sample and Data Sources

We began our sample selection with all firms listed on the S&P 500. To avoid survivorship bias, we collected data from all S&P 500 firms listed at least once by the end of the

year from 2002 to 2014. The initial sample comprised 789 companies. We excluded firms in the financial sector because the interpretation of accounting variables significantly varies in this sector (e.g., McNamara et al., 2003). This resulted in a sample of 531 companies and 981 CEOs. To limit endogeneity concerns, we further reduced the sample to newly appointed CEOs (i.e., with a tenure of two years or less), as they are exposed to a pre-defined organizational structure exogenous to their own choices. These screening decisions, together with missing data, resulted in a final sample of 281 CEOs from 216 firms.

Data were collected from various sources. We relied on Standard and Poor's Capital IQ and COMPUSTAT for accounting and stock market data. For our independent variables, we coded the organizational structure variables based on senior executive titles, as listed in EXECUCOMP (Girod and Whittington, 2015). Furthermore, CEOs' educational career, career diversity, and TMT tenure were evaluated by analysing the CEOs' biographies, which we obtained from the firms' websites or other websites such as Bloomberg or Crunchbase. Finally, we downloaded CEOs' letters to shareholders (LTS) from the companies' webpages.

## Variables

*CEOs' perceived environmental uncertainty.* We constructed the CEOs' perceived environmental uncertainty variable based on the information provided in the LTS. While earlier studies operationalized perceived uncertainty using surveys or interviews (e.g., Duncan, 1972; Lawrence and Lorsch, 1967), more recent studies have relied on the human coding of written company information (e.g., Lant et al., 1992). We extended these studies by using computer-aided text analysis (CATA), which allows for the analysis of large amounts of textual data more 'systematically, comprehensively, and exhaustively' (Rynes and Gephart, 2004, p. 459). Extracting information about senior managers' perceptions from textual data, such as LTS, is an established approach in the strategic management literature (e.g., Duriau et al., 2007; Nadkarni and Barr, 2008; Nadkarni and Narayanan, 2007). This approach is based on the Sapir–Whorf hypothesis, which suggests that the perceptions through which individuals attend to the world are embedded in the words they use (Sapir, 1944; Whorf, 1956). Appendix A in Supporting Information details our CATA procedure for operationalizing CEOs' perceived environmental uncertainty.

*Objective environmental uncertainty.* To measure environmental uncertainty from accounting data, we replicated Keats and Hitt's (1988) measure. This widely used measure (e.g., Heeley et al., 2006) divides environmental uncertainty into three dimensions: munificence, instability,<sup>[2]</sup> and complexity. We assessed these dimensions based on the four-digit SIC codes for each industry (Heeley et al., 2006) and performed a factor analysis to aggregate them. Munificence is measured as the regression coefficient of the natural logarithm of net sales in each industry, with time serving as the independent variable (Palmer and Wiseman, 1999). Instability was operationalized as the standard error of the above-noted regression. Complexity was measured using the Herfindahl index to quantify the industry concentration. We performed a principal components factor analysis and extracted the

first factor, which revealed an eigenvalue of 1.23, accounting for 41 per cent of the total variance of the three input factors.<sup>[3]</sup>

*CEOs' environmental perception gap.* We measured CEOs' environmental perception gaps, which reflect the difference between CEOs' personal assessment of environmental uncertainty and an assessment based on environmental accounting data, as the difference between the standardized values of the perceived and objective measures of environmental uncertainty.<sup>[4]</sup> Our approach is similar to the one adopted by Li and Tang (2010), who integrated personal perceptions and firm-level objective data into a combined variable. In the present case, standardization was necessary in order to make the scales of our two variables comparable. Furthermore, we used the absolute value of the difference between these variables because our theory does not specify the direction of the resulting differences.

*Organizational structure.* Our main arguments reflect the idea that organizational structure fundamentally shapes how information is processed by CEOs. We believe that executive-title-based measures of structure are suitable indicators for examining the theoretical mechanisms at the centre of our study. CEOs routinely interact with their fellow executives, who bear functional and/or divisional responsibilities, which are reflected in their titles and which have a bearing on the manner in which they frame issues and communicate with one another. Based on this logic, we relied on previous studies to construct organizational structure variables based on senior executive titles (e.g., Albert, 2018; Girod and Whittington, 2015). Specifically, for each organization in our database we divided the number of function- and division-related senior executive titles by the total number of senior executive titles (Girod and Whittington, 2015). Whereas previous research has tended to code organizational structure as a dichotomous variable (e.g., Young et al., 2004), our approach allows for more nuances and potentially compound or hybrid organizational structures, which are becoming increasingly prevalent (Girod and Whittington, 2015). We lagged our organizational structure variables by one year.

*CEOs' independent reasoning ability.* H2a and H2b predict that CEOs' independent reasoning ability moderates the organization structure – CEO environmental perception gap association and that arguments from three related bodies of work pertaining to education, career diversity, and TMT experience substantiate these predictions. Based on these arguments, we operationalized CEOs' independent reasoning ability by means of three proxy variables: (1) educational career, (2) career diversity, and (3) TMT tenure. In line with previous studies (e.g., Papadakis et al., 1998; Smith et al., 2005), we operationalized educational career by coding the CEO's educational background. A PhD, master's degree, bachelor's degree, and high school diploma were assigned values of four, three, two, and one, respectively. We operationalized career diversity as the number of previous industries and firms in which a CEO worked relative to their overall work experience in years (Crossland et al., 2014). We coded the number of previous industries based on each firm's two-digit Global Industry Classification Standard code (Crossland et al., 2014). Furthermore, we counted the number of firms in which each of the CEOs worked prior to their current jobs

(Crossland et al., 2014). In contrast to Crossland et al. (2014), we were unable to reliably collect data on the number of different functions in which CEOs worked. In particular, for long-tenured CEOs, biographies were vague regarding previous functional positions. When aggregating the number of previous industries and firms, we standardized them because they had substantially different means (0.74 and 2.1, respectively). The final combined measure represents the sum of the standardized number of previous industries and firms in relation to overall work experience. Finally, we operationalized *TMT tenure* as the number of years since the CEO became part of the TMT (e.g., Finkelstein and Hambrick, 1990).

*Control variables.* We controlled for various factors that could provide alternative explanations to our hypotheses. First, a firm's size and exposure to different industries may simultaneously affect its organizational structure and the CEO's ability to assess environmental uncertainty (Girod and Whittington, 2017; Keats and Hitt, 1988). Accordingly, we controlled for firm size using the natural logarithm of employees (e.g., Garg et al., 2003; Girod and Whittington, 2015, 2017) and the degree of diversification using an entropy measure of relative sales in different industries (Palepu, 1985). In addition, industry-level differences and differences in the macroeconomic environment affect organizational structure, and thus pose difficulties when assessing environmental uncertainty (e.g., Fjeldstad et al., 2012; Nadkarni and Barr, 2008; Nadkarni and Narayanan, 2007). To address these concerns, we controlled for industry-specific characteristics using asset intensity per industry (i.e., assets to sales) and macroeconomic conditions by including real gross national product growth and consumer price index growth (e.g., McNamara et al., 2003). We lagged our firm- and industry-related control variables by one year.

Furthermore, we controlled for individual-level factors. We controlled for CEO age, as perceptions and interpretations of the environment might vary with life experience (e.g., Chatterjee and Hambrick, 2011). We did not include CEO tenure as we restricted our sample to the first two years in the focal position. However, we conducted a robustness check, including CEO tenure (see Appendix E in Supporting Information). We included CEO duality, which was assigned a value of 1 if the CEO was also a chairman and 0 if otherwise (e.g., Chatterjee and Hambrick, 2011). CEOs who hold both positions generally have more power and are less supervised by the board (e.g., Schepker and Oh, 2013). The resulting lack of feedback and information from the board and independent chairman might also influence environmental (mis)perceptions. Finally, we controlled for CEOs' field of study. CEOs with backgrounds in certain fields may select firms which differ in terms of their environments and organizational structures. We included four dummy variables for the field of study: engineering, mathematics, computer science; economics or business; science, such as biology, chemistry, physics, medicine, and psychology; and other. In addition, because various factors that change over time (e.g., economic conditions) might affect individuals' ability to assess the environment (e.g., Girod and Whittington, 2015, 2017; McNamara et al., 2003), we included calendar-year dummies.

## Model

The variance in our dependent variable is derived from annual firm-related changes. Most firms, including those operating in similar industries and markets, show substantial

idiosyncrasies in their environments. Their products or services typically vary in terms of various underlying characteristics (e.g., technology, quality, and market share). This variety can only be captured through firm fixed effects. Accordingly, we structured our dataset using a firm-level annual panel. A Hausman test indicates systematic firm-level differences ( $p < 0.01$ ). Accordingly, we implemented a firm fixed effects model with clustered standard errors at the firm level. This model accounts for both observed and unobserved time-constant variables and addresses the endogeneity caused by time-invariant omitted variables.

## RESULTS

Table I presents descriptive statistics and pairwise correlations for the main variables. The highest correlation ( $-0.61$ ) is between functional and divisional structures and matches the argument that most firms implement only one of these two structural alternatives in empirical reality (Daft, 2015). Although this correlation is still below the absolute threshold value of 0.7, which is often considered the upper boundary for indicating multicollinearity in the independent variables (e.g., Judge et al., 1982; Kalnins, 2018), we still tested each variable separately in our models to ensure that our results were not hampered by multicollinearity.

Table II shows the results of our robust firm fixed effects models, which examined the influence of organizational structure on CEOs' environmental perception gaps. In addition to the effects of the control variables documented in Model 1 (indicating, inter alia, that senior managers occupying the dual role of chairman and CEO have lower environmental perception gaps), we find that the post-economic-crisis years from 2009 to 2012 (not shown separately in Table II) have a positive significant effect on CEOs' environmental perception gaps. This finding is in line with our expectation, as changed environmental conditions in the post-crisis years make CEOs' established information-processing heuristics less likely to be aligned with the actual state of the objective environment.

In our testing of Hypotheses 1a/b, Model 2 in Table II provides support for our prediction that a higher degree of functional structure increases CEOs' environmental perception gaps ( $\beta = 1.959$ ;  $p < 0.01$ ; Hypothesis 1a). The opposite holds true in respect of our prediction pertaining to the corresponding effect of divisional structure ( $\beta = -2.562$ ;  $p < 0.01$ ; Hypothesis 1b), which is tested in Model 3. These results hold regardless of whether we consider the variables separately or in combination.

To further ensure that the inclusion of control variables does not drive our results, we re-evaluated Models 2 and 3 after excluding all variables, except the year dummies and two independent variables. These tests confirmed our initial results ( $\beta = 1.609$ ;  $p < 0.05$ ;  $\beta = -2.125$ ;  $p < 0.01$ ), indicating that firm fixed effects play an important role in our models (as suggested by the Hausman test). The role of firm level effects is additionally emphasized when analysing the pairwise correlations between our dependent and organizational structure variables. We find low and non-significant correlations between functional ( $-0.02$ ) and divisional ( $0.05$ ) structure and CEOs' environmental perception gap (see Table I). The fixed effects transformed variables, i.e., the actual value minus the

Table I. Descriptive statistics and correlations

Variables	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12
1. CEOs' environmental perception gap	1.05	0.89	0.00	5.01												
2. Functional structure	0.38	0.18	0.00	0.80	-0.02											
3. Divisional structure	0.19	0.19	0.00	0.75	0.05	-0.61*										
4. Educational career	2.64	0.82	0.00	4.00	-0.10	-0.01										
5. Career diversity	0.01	0.07	-0.15	0.32	-0.01	0.11*	-0.11*	0.07								
6. TMT tenure	5.45	5.21	0.00	33.0	-0.01	-0.01	-0.06	-0.09	0.15*							
7. CEO age	52.5	5.39	37.00	67.0	-0.07	-0.06	0.04	0.02	0.02	0.16*						
8. Duality	0.85	0.36	0.00	1.00	0.03	-0.06	0.11	-0.07	0.02	0.03	0.02					
9. Asset intensity	1.55	1.01	0.26	5.47	-0.09	-0.03	0.13*	0.09	0.03	0.07	0.07	0.05				
10. Firm size (log)	10.0	1.29	6.31	14.6	-0.01	-0.05	-0.06	0.04	0.01	0.06	0.07	-0.01	-0.39*			
11. Degree of diversification	1.17	0.53	0.00	3.14	-0.06	0.07	-0.06	0.00	-0.12*	-0.04	0.04	0.02	-0.01	0.13*		
12. Consumer price index	2.33	1.11	-1.04	4.37	-0.05	-0.19*	0.06	0.04	0.10	0.00	-0.07	0.09	0.01	0.05	-0.12*	
13. Gross national product	1.76	1.72	-3.46	4.36	-0.07	-0.18*	0.07	0.08	0.02	-0.02	-0.00	0.05	0.01	0.10	-0.08	0.52*

Note: N = 330.  
\*p < 0.05.



Table II. FE model results – organizational structure on CEOs' environmental perception gaps

<i>Variables</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>	<i>Model 5</i>	<i>Model 6</i>	<i>Model 7</i>	<i>Model 8</i>	<i>Model 9</i>	<i>Model 10</i>
Constant	-1.351 (3.245)	-1.474 (2.920)	1.300 (3.538)	-1.802 (3.333)	-4.462 (2.779)	1.467 (3.281)	-1.104 (2.832)	1.558 (3.509)	-2.793 (2.802)	0.859 (3.362)
Asset intensity <sub>t-1</sub>	0.049 (0.146)	0.163 (0.152)	0.140 (0.151)	0.051 (0.147)	0.100 (0.153)	0.084 (0.160)	0.176 (0.139)	0.154 (0.150)	0.101 (0.153)	0.139 (0.154)
Firm size (log) <sub>t-1</sub>	0.186 (0.278)	0.140 (0.253)	-0.052 (0.312)	0.217 (0.268)	0.273 (0.238)	0.019 (0.277)	0.110 (0.251)	-0.065 (0.319)	0.220 (0.224)	-0.010 (0.292)
Degree of diversification <sub>t-1</sub>	0.099 (0.300)	0.082 (0.330)	-0.121 (0.316)	0.131 (0.304)	0.110 (0.289)	-0.055 (0.329)	0.080 (0.309)	-0.149 (0.321)	0.091 (0.319)	-0.086 (0.334)
Consumer price index <sub>t-1</sub>	0.029 (0.123)	0.074 (0.120)	0.018 (0.112)	0.028 (0.128)	0.108 (0.116)	0.047 (0.108)	0.089 (0.114)	0.018 (0.114)	0.027 (0.105)	0.026 (0.114)
Gross national product <sub>t-1</sub>	0.075 (0.129)	0.010 (0.121)	0.050 (0.115)	0.071 (0.136)	0.011 (0.110)	0.014 (0.112)	0.076 (0.114)	0.053 (0.116)	0.037 (0.102)	0.051 (0.121)
CEO age	-0.015 (0.017)	-0.017 (0.016)	-0.009 (0.015)	-0.017 (0.017)	-0.017 (0.014)	-0.007 (0.015)	-0.017 (0.015)	-0.009 (0.014)	-0.019 (0.016)	-0.011 (0.015)
Duality	-0.427* (0.216)	-0.376 (0.203)	-0.469* (0.196)	-0.452* (0.228)	-0.321 (0.174)	-0.410* (0.190)	-0.387 (0.221)	-0.488* (0.205)	-0.252 (0.202)	-0.490* (0.207)
Field of study										
Engineering, mathematics, and computer science	0.042 (0.403)	-0.222 (0.440)	0.034 (0.393)	0.077 (0.437)	-0.378 (0.433)	-0.184 (0.371)	-0.257 (0.418)	-0.079 (0.372)	-0.139 (0.447)	0.020 (0.394)
Economics	0.695* (0.316)	0.569 (0.355)	0.746* (0.328)	0.743* (0.343)	0.350 (0.364)	0.575 (0.313)	0.545 (0.336)	0.695* (0.292)	0.642 (0.356)	0.757* (0.329)
Sciences (biology, chem- istry, physics, medicine, psychology)	0.876 (0.576)	0.657 (0.653)	0.710 (0.508)	0.910 (0.593)	0.354 (0.622)	0.478 (0.468)	0.578 (0.630)	0.664 (0.460)	0.765 (0.637)	0.678 (0.488)
Others	0.471 (0.420)	0.235 (0.431)	0.430 (0.416)	0.517 (0.495)	-0.369 (0.491)	0.046 (0.443)	0.094 (0.429)	0.260 (0.402)	0.354 (0.437)	0.440 (0.426)

Table II. (Continued)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Functional structure <sub>t-1</sub>		1.959** (0.702)			7.533*** (1.983)		2.117** (0.695)		3.097*** (0.814)	
Divisional structure <sub>t-1</sub>			-2.562** (0.807)			-6.188** (2.180)		-2.655** (0.836)		-2.724** (0.916)
Educational career				0.024 (0.173)	0.723** (0.257)	-0.340 (0.219)				
Career diversity				0.511 (1.394)			5.945* (2.917)	-1.781 (1.864)		
TMT tenure				0.015 (0.023)					0.140** (0.048)	0.021 (0.029)
Functional structure <sub>t-1</sub> × educational career					-2.195** (0.671)					
Divisional structure <sub>t-1</sub> × edu- cational career						1.323 (0.708)				
Functional structure <sub>t-1</sub> × career diversity							-15.750* (7.973)			
Divisional structure <sub>t-1</sub> × career diversity								9.678 (6.930)		
Functional structure <sub>t-1</sub> × TMT tenure									-0.334** (0.105)	
Divisional structure <sub>t-1</sub> × TMT tenure										0.018 (0.146)
F	5.646***	6.335***	5.372***	5.063***	6.398***	5.298***	5.541***	5.583***	7.838***	4.938***
R <sup>2</sup> (within)	0.2503	0.2997	0.3170	0.2557	0.3553	0.3398	0.3193	0.3270	0.3507	0.3263

Note: N = 330, Standard errors in parentheses.  
\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

firm's mean value over time of the focal variable, show a significant and higher pair-wise correlation between functional structure (0.17), divisional structure (−0.18), and our dependent variable. These findings further increase confidence in our theory and associated empirical models. They also imply that firm-level differences are important for explaining such perception gaps, which is conceivable given that firms are exposed to idiosyncratic environments with unique combinations of industries, markets, products, and stakeholders.

The importance of firm-level fixed effects revealed by our results raises another interesting question. Given our decision to restrict our sample to CEOs in the first two years of their tenure, the question arises as to whether some of the firm fixed effects we have observed reflect a CEO fixed effect. An ideal empirical setup for separating firm from CEO fixed effects would require a firm-CEO matched panel that followed the same CEOs across multiple firms over time (Bertrand and Schoar, 2003). As this requirement was not a consideration in designing the study, our sample contained only five CEOs who had held CEO positions across the sampled firms, rendering a meaningful analysis unfeasible. Therefore, we adopted the alternative strategy of incorporating random subsamples of CEO dummies into our firm fixed effects models. The inclusion of every CEO dummy would not allow for statistically meaningful analyses, as this approach would incorporate almost as many CEO dummies (281) as overall observations (330). Instead, we tested a large variety of alternative CEO subsamples, which provided consistent support for the above-documented main effects (by way of illustration, Table III reports our findings in batches of 70). The increase in  $R^2$  suggests that both firm fixed effects and CEO fixed effects contribute to CEOs' environmental perception gaps. However, we conclude that irrespective of firm or individual idiosyncrasies, organizational structure does, nevertheless, ultimately influence these gaps.

Concerning Hypotheses 2a/b, from Model 4 onward (Table II), we evaluate whether (1) educational career, (2) career diversity, and (3) TMT tenure (as approximations of CEO independent reasoning ability) moderate the extent to which organizational structure manifests in CEOs' perception gaps. Models 5 and 6 (educational career), Models 7 and 8 (career diversity), and Models 9 and 10 (TMT tenure) consistently show that CEO independent reasoning ability moderates the positive association between functional structure and our dependent variable, thus confirming Hypothesis 2a. For example, according to Model 5, a higher level of education attenuates the direct positive effect of functional structure on the gap variable by a beta of −2.195 ( $p < 0.01$ ). This is compared to the beta of 7.533 ( $p < 0.001$ ) in the main effect.

Notably, however, we did not find any evidence for Hypothesis 2b; i.e., none of the three proxy variables we employed to assess CEO independent reasoning ability attenuated the negative effect of divisional structure on CEO bias. These counter-intuitive, contrasting findings are particularly interesting. They imply that whereas independent reasoning ability is a potentially useful means for eradicating perception biases associated with functional structure, it is not useful for eradicating such biases arising from divisional structures. In other words, while this ability helps reduce an increasing bias associated with functionalization, it does not help to attenuate already diminishing biases associated with divisionalization. Figure 1 illustrates the moderating effects thus observed.

Table III. FE model results – organizational structure on CEOs’ environmental perception gaps including CEO dummies

<i>Variables</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>	<i>Model 5</i>	<i>Model 6</i>	<i>Model 7</i>	<i>Model 8</i>
Constant	−3.843 (2.626)	−2.985 (3.615)	1.128 (4.158)	0.265 (4.096)	−1.576 (3.099)	0.878 (4.519)	6.364 (3.939)	1.874 (4.086)
Asset intensity <sub><i>t</i>−1</sub>	−0.108 (0.141)	0.479** (0.170)	0.145 (0.188)	0.090 (0.186)	−0.083 (0.146)	0.294 (0.191)	0.212 (0.205)	0.075 (0.191)
Firm size (log) <sub><i>t</i>−1</sub>	0.333 (0.229)	0.145 (0.311)	−0.101 (0.384)	−0.065 (0.399)	0.211 (0.261)	−0.033 (0.370)	−0.546 (0.403)	−0.213 (0.395)
Degree of diversification <sub><i>t</i>−1</sub>	0.104 (0.378)	0.164 (0.381)	0.477 (0.368)	−0.025 (0.397)	−0.169 (0.396)	−0.157 (0.382)	0.249 (0.391)	−0.185 (0.413)
Consumer price index <sub><i>t</i>−1</sub>	0.099 (0.112)	0.077 (0.163)	0.037 (0.217)	0.035 (0.136)	0.073 (0.100)	−0.012 (0.139)	−0.054 (0.196)	0.012 (0.124)
Gross national product <sub><i>t</i>−1</sub>	−0.069 (0.097)	−0.080 (0.114)	0.039 (0.165)	0.026 (0.133)	−0.053 (0.087)	−0.016 (0.109)	0.072 (0.175)	0.024 (0.126)
CEO age	0.001 (0.017)	−0.007 (0.020)	−0.025 (0.023)	−0.001 (0.018)	0.002 (0.016)	−0.006 (0.023)	−0.016 (0.022)	0.007 (0.019)
Duality	−0.365 (0.255)	−0.326 (0.347)	−0.327 (0.232)	−0.238 (0.316)	−0.498* (0.252)	−0.545 (0.350)	−0.426 (0.224)	−0.282 (0.301)
Field of study								
Engineering, mathematics, and computer science	−0.307 (0.427)	−0.396 (0.629)	−0.713 (0.488)	−0.0554 (0.775)	−0.061 (0.406)	0.074 (0.604)	−0.414 (0.386)	0.447 (0.734)
Economics	0.644* (0.279)	0.860 (0.490)	0.00799 (0.438)	0.513 (0.731)	0.773** (0.277)	1.043* (0.517)	0.368 (0.312)	1.036 (0.693)
Sciences (biology, chemistry, physics, medicine, psychology)	0.577 (0.611)	1.206 (0.640)	1.834** (0.584)	−0.276 (0.786)	0.707 (0.468)	1.086 (0.572)	1.616*** (0.436)	0.437 (0.740)

(Continues)

Table III. (Continued)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Others	0.585 (0.388)	0.216 (0.626)	-0.602 (0.543)	0.297 (0.770)	0.702 (0.392)	0.419 (0.566)	-0.282 (0.425)	0.839 (0.757)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CEO dummies (CEO 1-70)	Yes				Yes			
CEO dummies (CEO 71-140)		Yes				Yes		
CEO dummies (CEO 141-210)			Yes				Yes	
CEO dummies (CEO 211-281)				Yes				Yes
Functional structure <sub>t-1</sub>	1.215 (0.706)	2.985*** (0.865)	2.344*** (0.755)	1.488* (0.655)				
Divisional structure <sub>t-1</sub>					-1.950** (0.698)	-2.810** (1.028)	-3.183** (0.968)	-1.959* (0.861)
R <sup>2</sup> (within)	0.5781	0.5018	0.4620	0.5262	0.5901	0.4780	0.4766	0.5283

Note: N = 330, Standard errors in parentheses.  
\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

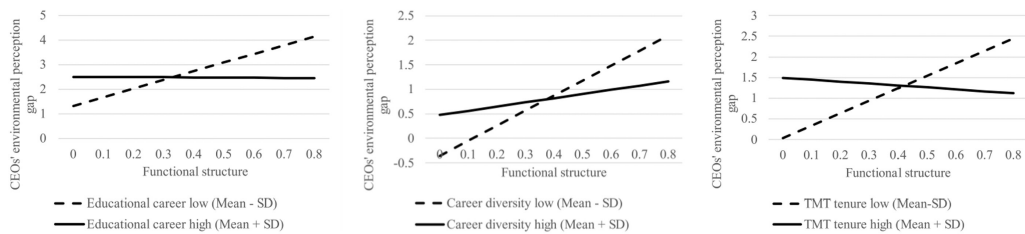


Figure 1. Moderating effects of educational career, career diversity, and TMT tenure

## ROBUSTNESS TESTS

We conducted a series of additional analyses to ensure the robustness of our results and rule out the possibility of our main findings being driven by methodological artefacts. These robustness tests pertain to our CEO environmental perception gap and organizational structure variables.

First, the construction of our dependent variable relies on the assumption that the content presented in LTS reflects CEOs' perceptions and judgements. While this assumption is common in the strategic management literature (e.g., Duriau et al., 2007; Nadkarni and Barr, 2008; Nadkarni and Narayanan, 2007), corporate communication departments can, and often do, alter the content of these documents. To investigate this possibility, we performed a panel analysis of the impact of CEO fixed effects on the CEOs perceived environmental uncertainty variable. The model revealed that such CEO fixed effects explain approximately 47 per cent of the total variance, implying that, irrespective of firm-, time-, or industry-specific influences, almost half of the variance in our CEOs' perceived environmental uncertainty variable is due to individual differences at the CEO level.

Second, we conducted a robustness test devised to rule out the possibility that impression management tactics on the part of corporate communication departments (e.g., Bolino et al., 2008; Graffin et al., 2011) might have unduly had an impact on our CEO perceived environmental uncertainty variable. Specifically, previous studies indicate that LTS may 'suffer from attempts of impression management' (Nadkarni and Barr, 2008, p. 1404), for instance, CEOs sometimes use 'accounts, apologies, excuses, and justification [...] to make their organizations look less responsible' and minimize the consequences of controversial events (Bolino et al., 2008, p. 1102; Elsbach and Sutton, 1992). In Appendix C in Supporting Information, we detail how we searched and corrected for such expressions. Our findings remained largely unaffected.

Third, we evaluated the robustness of our results pertaining to organizational structure by (a) evaluating alternative operationalizations (i.e., continuous and dichotomous alternatives) of our original executive title derived variable and by (b) approximating the organizational structure variables from an entirely different data source: Specifically, according to the Financial Accounting Standards Board (FASB) ASC 280-10-50-12, the policy document underpinning US GAAP, firms must adjust their financial reporting when a given product or industry segment accounts for at least 10 per cent of their profits or losses (Flood, 2019). We used this policy reporting requirement to construct an additional alternative proxy for



organizational structure. Our logic is that the more a firm reports along product-segment lines (i.e., the more profit generated from divisional segments), the more likely it is to emphasize divisional structures representing these product-segment lines. Once again, we find negative associations between the degree of divisional structure and CEOs' environmental perception gaps. These additional results confirm the robustness of our substantive findings in respect of organizational structure, thus increasing our confidence that they are unlikely to merely reflect methodological artefacts. Appendix D in Supporting Information details and summarizes these additional tests aimed at the operationalization of organization structure.

We also conducted several robustness tests to rule out the possibility that the financial crisis of 2007 and 2008, which was encompassed in our sampling period, had not unduly influenced our main results. The results of these additional tests (reported in Appendix E in Supporting Information) similarly confirm the robustness of our substantive findings.

## POST HOC ANALYSES

We performed post hoc analyses in order to evaluate two important underlying assumptions pertaining to our study. The first such assumption is that organizational structure influences CEOs' attention. To evaluate this assumption, we performed a post-hoc content analysis of the sample firms LTS to explore the extent to which key structural features directly manifest in CEOs' language, as encapsulated in these documents (likely reflecting their attention patterns). Our findings revealed that the greater the emphasis on functional and/or divisional structure, the more CEOs use function- or division-oriented words. These results highlight an intermediate mechanism in our theory, namely, that organizational structures guide CEOs' attention to particular sources of information, thus ultimately influencing their (mis)perceptions (see Ocasio, 1997). A detailed description of this post hoc analysis and its results are documented in Appendix F in Supporting Information.

The second underlying assumption we investigated post-hoc is that CEOs' environmental perception gaps are consequential for the performance of their firms. To evaluate this assumption, we examined the association between CEOs' environmental perception gaps and subsequent accounting (i.e., ROA) and stock market-based (i.e., Tobin's Q) performance. The detailed analysis is explained and reported in detail in Appendix G in Supporting Information. In outline, in keeping with our expectations, we found significant negative associations in respect of both dependent variables. Collectively, these results suggest that the more CEOs are out of sync with their organizations' environments, the worse the performance consequences.

## DISCUSSION

This study has shown that organizational structure has an important bearing on the manner in which CEOs process information pertaining to the competitive environments of their firms. Furthermore, we have demonstrated that the information processing shortcuts (i.e., heuristics) we have observed are not independent of individual differences between our CEOs. In the following discussion, we highlight the insights that these findings provide for the literatures pertaining to heuristics and biases in

strategic management (e.g., Das and Teng, 1999; Hodgkinson et al., 1999; Maule and Hodgkinson, 2002; Schwenk, 1984), upper echelons (Hambrick and Mason, 1984), behavioural strategy (e.g., Hodgkinson and Healey, 2011; Levinthal, 2011; Powell et al., 2011), and environmental uncertainty (e.g., Duncan, 1972; Garg et al., 2003; Nadkarni and Barr, 2008).

We make two important contributions to the heuristics and biases literature in strategic management. First, our study is one of the few that has directly investigated the influence of organizational structure on individual-level cognitive biases. Notably, previous studies have predominantly focused on individual level factors and wider organizational-level influences that have a bearing on decision makers' mental models of the competitive environment (e.g., Daniels et al., 1994; Hodgkinson and Johnson, 1994) rather than the influence of organizational structure on heuristics and biases, as such (see Das and Teng, 1999; Zajac and Bazerman, 1991). While we highly value the voluminous body of work pertaining to cognitive heuristics (and biases) in general, we believe an important factor that differentiates managers from human decision makers in general (Evans, 1989) is the organizational context. Organizations, which are characterized by social complexity, manifest through a wide-ranging assortment of hierarchical and network-based interdependencies (e.g., Csaszar and Ostler, 2020; Foss and Weber, 2016), offer fertile ground for exploring the interplay of multilevel influences on the way in which individuals pursue 'good enough' (instead of optimal) solutions. Our results have shown that organizational structure, which is primarily focused on the efficient and effective division of labour rather than the development of heuristics, affects senior managers' information processing shortcuts. This mismatch is particularly noteworthy as effective information processing shortcuts become increasingly important in times of exponential increases in data and information.

Our second contribution is related to our research design, which enabled us to differentiate between organizational- and individual-level influences on senior managers' heuristics. Extant studies have mostly focused on associating individual-level information processing arguments with organizational-level constructs, such as routines or organizational learning (Bingham et al., 2019; Bingham and Eisenhardt, 2011), making it difficult to tease apart the role of heuristics in organizations. In contrast, our study has demonstrated a clear relationship between organizational structure and individual-level information processing outcomes. Given our sample of newly appointed CEOs exposed to a predefined (i.e., exogenous to their own choices) organizational structure, our results have shown that structure has a direct influence on senior managers' heuristics. This is an important contribution to the management field, which rarely examines empirically the all-important question of how stable individual-level information processing tendencies such as heuristics affect organizational-level information processing, and vice versa (Sutcliffe, 1994). The micro-foundations perspective (Foss, 2003) directly addresses this question at a more general level by exploring the extent to which and in what ways individual-level characteristics and tendencies manifest at the organizational level and, conversely, the role of top-down causal emergents such as organizational structure, culture, and routines as enablers and constraints of individual and collective behaviour. According to our

findings, the organizational level (represented by organizational structure) has an additional and independent effect (Hypotheses 1a and 1b), as well as an interdependent (Hypothesis 2a) effect on managers' information processing shortcuts.

Our findings also have important implications for the burgeoning upper echelons literature (Hambrick, 2007; Hambrick and Mason, 1984). The upper echelons perspective interprets organizations as reflections of their senior managers. Our results have shown that organizational characteristics also shape senior managers' perceptions and judgements. In traditional upper echelons arguments, senior managers affect their organizations through strategic decisions. However, according to our results, senior managers' judgements and perceptions that precede strategic decisions are partly shaped by organizational characteristics. In other words, senior managers make decisions based on the information provided to them through the lens of their organizations. Similarly, in line with previous upper echelons claims, our results have indicated that managerial background characteristics manifest in organizational outcomes and, notably, that this is due to an indirect information processing mechanism. Recent studies call for a deeper examination of such interrelations, claiming that 'upper echelons research has primarily examined how various background characteristics of executives directly influence their strategic choices (...); by comparison, the information filtering processes theoretically linking personal characteristics and strategic decision have been relatively overlooked' (Steinbach et al., 2019, p. 873).

Our study also provides insights into the emerging behavioural strategy perspective (Levinthal, 2011; Powell et al., 2011), a body of work that builds on the heuristics and biases literature in strategic management (e.g., Das and Teng, 1999; Maule and Hodgkinson, 2002; Schwenk, 1984), but also extends well beyond it (see Hodgkinson and Healey, 2011; Huy, 2011; Powell et al., 2011). Behavioural strategy combines behavioural and economic perspectives and suggests that performance differences (or rents) stem variations in executive judgement (Levinthal, 2011). Our findings demonstrate that good and bad executive judgements are not only a reflection of biased and unbiased individuals but also a reflection of organizational-level mechanisms that have a material bearing on what information is attended to, overlooked, and ignored, and how information selected for processing is ultimately evaluated and acted upon. In short, organizational structure functions as a source of both good and poor executive judgement. As such, it translates into competitive (dis)advantage.

Our study also contributes to the literature on the measurement of environmental uncertainty. Since the seminal study by Lawrence and Lorsch (1967), scholars have attempted to measure perceived environmental uncertainty, mostly by relying on interviews and surveys (Duncan, 1972; Garg et al., 2003). We have developed a longitudinal approach to measurement that can be applied to large samples over long time periods. This approach to data collection helps to improve external validity, which is normally challenging for measurement approaches using surveys and interviews (e.g., Duriau et al., 2007). By incorporating documentary sources of data, our approach should help ensure internal validity, which is often challenging for large sample studies (e.g., Duriau et al., 2007).

Finally, our methods help to address a longstanding problem associated with LTS, namely, 'impression management' (Nadkarni and Barr, 2008, p. 1404), through which, 'accounts, apologies, excuses, and justification' can be used to mitigate the potentially negatives consequences of poor organizational outcomes (Bolino et al., 2008, p. 1102;

Elsbach and Sutton, 1992). Our approach to data analysis addresses directly these sorts of tactics, offering a systematic way to correct for them.

### Limitations and Future Studies

Similar to previous studies (e.g., Csaszar and Levinthal, 2016; Nadkarni and Barr, 2008), we assume that information processing is the unifying mechanism most likely to be at the intersection of our main independent and dependent variables. A possible extension of our work is a more direct identification of managers' information processing, for example, via relying on cognitive mapping (Hodgkinson and Healey, 2008; Hodgkinson and Sparrow, 2002; Markóczy, 1997).

Moreover, following previous studies (e.g., Cho and Hambrick, 2006; Kaplan et al., 2003; Nadkarni and Barr, 2008), our dependent variable is based on the assumption that CEOs' perceptions and judgements are evident in their words, as recorded in LTS. We conducted a variety of robustness tests to account for potential violations of this assumption. As our data indicate that 47 per cent of the variance in this perceptual measure is CEO-specific variation, we believe to have sufficient support for this central assumption, particularly given the previously mentioned disadvantages of alternative measures (e.g., survey-based measures). However, we cannot rule out the possibility that LTS might include other parties' perceptions and opinions (e.g., other members of the senior management team) or might be affected by other limitations associated with content analysis such as problems associated with inferred or assumed categories (Insch et al., 1997) and, therefore, encourage future work to evaluate the representation of CEOs' perceptions in LTS further.

Another possible extension of our study involves the randomization of the main independent variable. This would enable the development of a stronger causal claim regarding our main organizational structure-induced argument. Randomization is inherently difficult in field settings. Nevertheless, future studies could introduce randomization based on simulation experiments (e.g., Rahmandad, 2012). Although such studies in isolation pose external validity concerns, they are especially powerful when combined with fieldwork.

### CONCLUSION

This paper has advanced understanding of senior managers' information processing shortcuts by clarifying how organizational-level influences affect CEOs' (mis)perceptions of the competitive environment. Specifically, reporting the findings of an empirical study based on a sample of 281 CEOs from 216 firms, it has clarified how particular forms of organizational structure are associated with environment perception gaps of varied magnitudes. The findings show that such gaps tend to be wider in respect of CEOs of organizations with greater degrees of functional structure, whereas CEOs of organizations with greater degrees of divisional structure tend to hold significantly narrower perception gaps. These findings are important because the actions of firms largely depend on their senior managers' perceptions of the environment, and a potential misalignment between the perceived and the objective environment comes with performance penalties. Further work is required to illuminate the precise mechanisms through which, by channelling and filtering information in varied ways, these alternative structural forms

amplify and attenuate perceptual gaps of this nature, and our hope is that fellow researchers will be inspired to join us in the quest to tease out the normative implications of these rather intriguing findings.

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## NOTES

- [1] Divisional and functional structures are often measured as dichotomous variables (e.g., Young et al., 2004). In business reality, however, firms frequently adopt hybrid structures that combine functional (e.g., central HR department) and divisional (e.g., divisions for certain products without a HR department) elements. Accordingly, in the present study we operationalize functional and divisional structures as two separate continuous variables.
- [2] The description and measurement of instability is similar to that of “dynamism” (see Dess and Beard, 1984; Keats and Hitt, 1988).
- [3] Detailed results of our environmental uncertainty factor analysis can be obtained from the authors upon request.
- [4] Appendix B shows the average values of CEOs’ perceived uncertainty and environmental perception gaps over time. The graph shows that both variables vary over time. The curves partially proceed uniformly and are partially nonuniform. Hence, CEOs’ personal assessment of environmental uncertainty change over time, and neither CEOs’ personal assessment of environmental uncertainty nor the assessment based on environmental accounting data seem to dominate CEOs’ environmental perception gap.

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