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Alert and Awake: Role of alertness and attention on rate of new product introductions

Smita Srivastava[a,*], Arvin Sahaym[b], Thomas H. Allison[c]

[a] Department of Management, Box 88, Barton School of Business, Wichita State University, Wichita, KS 67260, United States
[b] Department of Management, Information Systems, and Entrepreneurship, Carson College of Business, Washington State University, Pullman, WA 99164, United States
[c] Department of Entrepreneurship and Innovation, Neeley School of Business, Texas Christian University, Fort Worth, TX 76109, United States

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ABSTRACT

Integrating the attention-based view and entrepreneurial alertness perspective, we develop our theoretical framework to test the influence of CEO attention and alertness on rate of new product introduction (NPI). We propose that a firm's rate of NPI is predicted independently and jointly by attention and alertness, two different yet complementary cognitive characteristics of the CEO. Using a sample of 271 US-based small and medium size enterprises (SMEs) from 2004 to 2015, we show that CEO's attention to R&D, customers, and competitors positively influence NPI, while attention to organization negatively impacts the relationship. We also find that CEO alertness has positive impact on the rate of NPI; however, high alertness hurts the rate of NPI. Such theoretical elaboration and empirical illustrations contribute to a better understanding of the micro-foundations of managerial cognition and its role in NPI. By adding alertness from entrepreneurship literature and explicating the nexus between alertness and attention, our study explains how some CEOs who are able to acquire novel information and stay focused are able to achieve higher rate of NPI.

1. Executive summary

In entrepreneurial firms where there is less formality, greater centralization, and fewer slack resources, CEOs play a crucial role in new product introduction (NPI). Two cognitive characteristics of CEOs that affect their perception of the environment and organization, namely, attention and alertness, significantly influence the effectiveness of new product development process. While academic research has explored how managerial attention to broad factors such as external and internal environment influence firm innovation performance, we still have only a limited understanding on how attention to more specific stimuli/objects such as organization, customers, R&D, and competitors influence NPI. Since attentional effectiveness depends on the stimuli/objects being attended to, and NPI is central to competitive advantage among entrepreneurial firms, there is a need to study the effects of a CEO's specific attention to key firm-level factors on NPI.

Similarly, the entrepreneurship literature has shown that CEO alertness—a radar equivalent capability of the decision makers to spot opportunities in the external environment that may have been overlooked— leads to positive firm innovation performance. However, there is a lack of understanding in how levels of alertness may influence NPI. As NPI is a complex process and requires CEOs to constantly acquire new information and combine it with firm level factors, decision makers will need both radar-like capability and

* Corresponding author.
E-mail addresses: smita.srivastava@wsu.edu (S. Srivastava), arvin@wsu.edu (A. Sahaym), t.allison@tcu.edu (T.H. Allison).

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attentional focus to achieve an efficient NPI. We propose that in an entrepreneurial firm NPIs are predicted independently and jointly by these two different yet complementary cognitive characteristics of the CEO.

Using a sample of 271 US-based small and medium size enterprises (SMEs) during 2004-2015, we show that CEO's attention to R&D, customers, and competitors positively influence.

NPI while attention to organization negatively affects the relationship. We also show that CEO attention to competitors has significantly greater impact on the rate of NPI than CEO attention to other factors such as customers, R&D, and organization. Since CEOs' cognitive capacity is bounded, and an important resource to entrepreneurial firms, it is valuable to know which stimuli/object should receive more attention. We find that although CEO alertness has a positive impact on the rate of NPI, high alertness harms the process. Next, we show that CEO attention to organizational details exacerbate the detrimental effects of high alertness, while attention to R&D and competitors mitigate such effects.

We contribute to theory and practice in three major ways. *First,* we contribute to the NPI literature by establishing micro-foundations for how two separate, yet complementary cognitive capabilities can be influential in determining a key strategic behavior of the firm, that is, NPI. *Second*, we help understand managerial cognition literature better by illustrating how CEO attention to specific stimuli related to the firm will have differential impact on the rate of NPI. We also extend the theory of attention by bringing the concept of alertness within its fold and developing a more holistic perspective to explain how the nexus between attention and alertness impact the rate of NPI. *Third,* we contribute to entrepreneurship literature by theorizing and empirically illustrating how Kirznerian alertness influences the rate NPI. By demonstrating that alertness is beneficial up to a certain point but may be hurtful beyond that, we contribute to our understanding of the optimum level of alertness for the key decision makers. As CEOs' cognitive capabilities are bounded and limited, but still play a key role in entrepreneurial firms, it is important to know their cognitive limits when studying firm level outcomes.

2. Introduction

Introducing new products is central to a firm's ability to adapt to a dynamic environment and gain a competitive advantage. However, the process of new product development from idea generation to product launch, is long and complex (Yadav et al., 2007). A CEO, particularly in small and medium enterprises (SMEs), plays an instrumental role in the new product development process, mainly through spotting opportunities, setting organizational priorities, allocating resources, and resolving problems (Lefebvre et al., 1997). A CEO's perception of the environment and the organization (Helfat and Peteraf, 2015) can significantly influence the effectiveness of new product development process.

Two streams of prior literature focus on the role of managerial perception or cognition in new product introduction. The first stream, embedded in behavioral strategy literature (Powell et al., 2011), focuses on managerial attention—the degree to which managers notice, interpret, and focus their time and effort on issues and on identifying answers (Kahneman and Egan, 2011; Ocasio, 1997). Findings from this literature stream suggest that managerial attention plays an important role in influencing the strategic choices of firms (Li et al., 2013; Nadkarni and Chen, 2014; Yadav et al., 2007). The theory of attention (Kahneman, 1973) suggests that attention is coupled with specific stimuli/objects and its effectiveness or ineffectiveness often depends on the stimuli/objects being attended to. However, prior research has defined the objects at a rather broad level—external environment and internal environment (Nadkarni and Barr, 2008; Yadav et al., 2007). As a result, we have a limited understanding of how managerial attention to more specific stimuli/objects such as competitors, customers, organization, and R&D may influence the strategic choices of firms, such as, new product introductions.

The second stream, embedded in entrepreneurship literature (Amato et al., 2017; Tang et al., 2012), focuses on another aspect of managerial cognition—alertness, defined as a decision maker's ability to identify opportunities in the external environment that have been overlooked (Kirzner, 1997). This literature suggests that alertness enables decision makers to acquire novel information from outside environment (Gaglio and Katz, 2001), connect the information in unique ways (Baron, 2006), and creatively process it to develop new product ideas (Amato et al., 2017). Although early research has shown a positive relationship between alertness and innovation performance (Tang et al., 2012), understanding the optimal level of sensitivity to external stimuli (Posner and Boies, 1971) in order to realize beneficial effects of alertness remains an unaddressed issue. For example, if the level of alertness is too low, the decision maker will fail to capture important signals. If it is too high, they will pick up a lot of information. Although the alertness and attention both capture the cognitive perceptions of the decision makers, we have a limited understanding on how these two jointly influence new product introductions, as the literature streams have evolved independently (Tang et al., 2012; Valliere, 2013a, 2013b; Valliere and Gegenhuber, 2013).

Rate of new product introductions is relevant in investigating these managerial perceptions as this process intends to create something new or novel (Katila and Ahuja, 2002) and requires CEOs to constantly acquire new information. On one hand, CEOs need a complex information acquiring capability, that is alertness, in order to receive external stimuli faster than others, and on the other hand, they need superior sensemaking, that is attention, to process the changes in the context of the firm, and decide on the future actions. As the cognitive capabilities of the CEOs are limited, and new product introduction process is complex, it is plausible to assume that CEOs will need both information seeking and sensemaking abilities in order to contribute to NPI in a meaningful way. Accordingly, in this study we first focus on CEO attention paid to the firm-related factors that are most relevant to the new product development and examine how do alertness and attention independently and jointly impact the rate of new product introductions.

Our study contributes to the existing literature in two ways. *First, by* combining the two separate yet complementary cognitive capabilities of the CEOs, alertness and attention, our study contributes to establish the *microfoundations* of how the decision makers' cognitive abilities influence a key strategic behavior—NPI (Devinney, 2013). This study also broadens the scope of the theory of

attention (Kahneman, 2011) by bringing the concept of alertness within its fold, and empirically examining how the capability of the CEOs to capture novel information from external environment and pay specific attention to firm related stimuli shape NPI. *Second,* we contribute to entrepreneurship literature by theorizing and empirically illustrating that alertness influences the rate of NPI—a firm level outcome, and in the process address some of the concerns raised by earlier literature (Gaglio and Winter, 2017; Klein, 2008). Contrary to prior research (Amato et al., 2017; Kaish and Gilad, 1991; Tang et al., 2012), our theory and results indicate that alertness is beneficial only up to a certain level, but detrimental after a point, we contribute to our understanding of the optimum level of alertness for entrepreneurs (Posner and Boies, 1971). Our novel empirical and contextual approach for understanding the impact of alertness on new product introduction offers deeper insights on the role of CEO cognition in resource constrained firms.

3. Conceptual background

3.1. CEO attention and alertness

Researchers in psychology literature suggest that there are two modes of mental activities that decision makers exercise while cognitively accessing and processing information. One, termed System 1 (Frederick, 2005; Kahneman, 2011), is an automatic mental activity that enables quick access and responses to external stimuli and data (Schneider and Shiffrin, 1977). The other mode, often referred to as 'controlled' or 'deliberative' mental processing, or 'executive function', is termed as System 2 (Kahneman, 2011). Mental activities of this type are slower and support a more deliberate response to circumstances (Schneider and Shiffrin, 1977). Attention, also known as System 2 (Kahneman, 2011), is defined as the degree to which decision makers are able to notice, interpret, and focus time and effort on issues and identifying answers (Ocasio, 1997). Drawing on the cognitive psychology literature (James, 1950; Kahneman, 1973, 2011; Knudsen, 2007; Mesulam, 1990; Smallwood, 2011), we can identify three important properties of attention— *selection, coupling, and boundedness*. *First*, attention involves giving greater preference to some stimuli over the others or selection of stimuli. *Second*, attention is tied to or coupled with specific stimuli or objects (James, 1950; Mesulam, 1990; Smallwood, 2011). Further, due to the selection and coupling, attention becomes deliberate in nature. *Third*, attention is bounded in nature as it draws upon cognitive capacity of the decision maker. Decision-makers allocate their attention to selected objects. This is often directed either to the stream of sensory information generated internally or to the physical realities arising externally (James, 1950; Mesulam, 1990; Smallwood, 2011). However, due to bounded nature of attention, it is difficult to observe multiple stimuli at the same time (Knudsen, 2007), hence attention to one object increases at the cost of attention to other objects (Stevens et al., 2015). Accordingly, attentional lapses are very commonly observed when coupling shifts from one stimulus to the other or from one physical reality to another (Smallwood, 2011).

Extending the concept of attention as drawn from the psychology (James, 1950; Kahneman, 1973; Smallwood, 2011) and neurology literature (Knudsen, 2007; Mesulam, 1990), the attention-based view of the firm suggests that the attentional pattern of the key decision makers (e.g. CEOs) will be focused on and directed by the firm level information (Barnett, 2008; Ocasio, 1997, 2011). It is reasonable to assume that CEO attention will be coupled to bundles of stimuli originating from organizational settings (Cho and Hambrick, 2006; Smallwood, 2011). However, due to the bounded nature of attention, CEOs will often face challenges in paying attention to multiple stimuli originating from different sources. Hence, focusing their attention on some issues while ignoring others will enable them to economize on their cognitive resources and address issues more efficiently (Nadkarni and Barr, 2008; Ocasio, 2011; Valliere and Gegenhuber, 2013).

Prior literature has highlighted the impact of CEO attention on firm-level outcomes such as the development of new products, firm innovation performance, and the speed of strategic actions (Eggers and Kaplan, 2009; Li et al., 2013; Nadkarni and Barr, 2008; Yadav et al., 2007). Attention is a deliberate action of decision makers to "identify issues and finding answers" (Ocasio, 1997, pp.189) that are related to their organization. Identifying issues in a timely manner helps firms improve their performance. While focusing on identifying issues or problems related to the firm is important for firm outcomes, so is identifying opportunities (Helfat and Peteraf, 2015). In fact, for firm outcomes such as introduction of new products, identifying opportunities may be even more important than identifying problems (Gaglio and Katz, 2001).

Identifying opportunities, especially for entrepreneurial firms, is not only challenging but also crucial for their long-term performance (Amato et al., 2017; Gaglio and Katz, 2001). Spotting opportunities in a timely manner requires that CEOs "keep their antenna out" (Zaheer and Zaheer, 1997), as valuable opportunities may arise infrequently. They essentially need to have something like a radar equivalent capability, like System 1, which is constantly switched on but operates at a low cost. In other words, detecting fleeting opportunities requires them to be in a state of alertness— the capability to develop and maintain an optimal sensitivity to external stimulation (Posner and Boies, 1971). Alertness includes cognitive processing (Oken et al., 2006; Posner and Petersen, 1990). The state of alertness can be defined as the capacity of the mind to respond appropriately to stimuli originating around the person (Moller et al., 2006). Studies have shown that alertness is a state of mind that is not coupled to any sources of stimuli (Moller et al., 2006; Parasuraman et al., 1998). An alert person captures signals faster, detects even the faint signals, and is able to process signals that occur infrequently (Oken et al., 2006; Posner and Petersen, 1990).

Prior literature in entrepreneurship has conceptualized alertness as an ability of an entrepreneur to notice, *without search efforts*, opportunities that have been overlooked (Kirzner, 1997). Alertness does not entail deliberate information seeking behavior, rather, it is a mental state that is sensitive to stimuli originating in the surrounding environment (Oken et al., 2006; Posner and Boies, 1971). An entrepreneur who is alert will be able to detect signals, identify stimuli related to opportunities and be able to capture signals faster than those who are less alert (Kirzner, 2009; Posner and Boies, 1971). This will enable the entrepreneurs to capture information on changes related to the market, technology, or even customers that are critical to the new product development. In addition,

alertness allows the entrepreneur to discover opportunities or connect knowledge and information of the society to specific initiatives within the firm (Vaghely and Julien, 2010). Thus, while alertness provides the entrepreneur with key information about objective conditions related to market developments or states of disequilibrium, it also supplies information of a more subjective nature (Alvarez and Barney, 2007; Valliere, 2013b).

Although the concept of alertness, originated in the Austrian entrepreneurship literature (Kirzner, 1997), has been associated with entrepreneurs, we argue that the concept can also be applied to the CEOs of small and medium size enterprises (SMEs), a role that is very similar to that of an entrepreneur. An SME depends on its CEO as a venture depends on the entrepreneur and faces similar obstacles in acquiring the external financial capital and growing the company as an entrepreneur does.

Though CEO alertness and CEO attention share some similarities, they differ in important ways. Both are cognitive constructs (Oken et al., 2006; Posner and Petersen, 1990; Valliere, 2013b), both relate to a CEO's perception of stimuli, and have implications for firm level outcomes (Tang et al., 2012; Yadav et al., 2007). However, they differ in the following fundamental ways. *First,* attention is more like a sleep-wake state where responsiveness to stimuli is not continuous (Oken et al., 2006) and is represented through the selective actions taken by the person (Knudsen, 2007). In this state, the responsiveness of brain is lower when the signal-to-noise ratio is low (McCormick and Feeser, 1990). However, in a state of alertness, the brain is more attuned to receive environmental stimuli as a continuous mode, even when the signal-to noise ratio is low (McCormick and Feeser, 1990; Posner and Petersen, 1990). Prior literature has argued that CEOs' often direct their attention to only a set of selective actions (Ocasio, 1997). Drawing on this literature, we propose that the CEOs' attention will work in the presence of a strong stimuli and will be manifested through the actions chosen by the decision makers. But alert CEOs will be able to spot unidentified stimuli, in the form of overlooked opportunities, even when the signal strength is low. In addition, unlike attention, which is, time bound, alert CEOs will be able to identify stimuli continuously without much of time lapses. Hence, alertness will enable the CEOs to be aware of the possible unidentified stimuli before window of opportunity closes.

Second, attention works by being coupled a stream of sensory information generated internally or to physical realities arising externally (James, 1950; Mesulam, 1990). So, attention is closely associated with the information or physical reality that it is coupled with.

But alertness is the mental state that maintains an optimal sensitivity to external environment (Posner and Boies, 1971) and works without being coupled to any particular source of information. *Third,* the two component processes that are fundamental to attention are a) working memory and b) competitive selection (Knudsen, 2007). Working memory holds a limited amount of information for a short period of time and only a selective set of information enter into the working memory through a highly competitive brain process. The decision maker's attention receives only the selected information that are stored in the working memory (Posner and Petersen, 1990). Studies have shown that novel stimuli that may enter into the working memory of the executives tend to fade away due to the inability of the memory to hold more tasks (Oken et al., 2006). Hence, decision makers are constrained in terms of their ability to attend to multiple stimuli. But alertness is more attuned to receiving continuous stimuli. Hence, CEOs who are alert will be able to maintain an optimal sensitivity to stimuli arising from multiple sources.

3.2. CEO attention, alertness and new product introduction

Scholars have suggested that *detection and development* are two core activities of NPI. These activities are geared towards identification of new technologies or new ideas and converting those to actual final products that can be launched in the market (Li et al., 2013; Yadav et al., 2007). As central decision makers of the firm, CEOs are key in identifying new opportunities. They play an instrumental role in bringing new ideas, needs, and opportunities to the attention of other members of the firm (Eggers and Kaplan, 2009; Van de Ven, 1986; Yadav et al., 2007). As new product development is a complex and time sensitive process (Kiss and Barr, 2017), CEOs' cognitive capabilities will play a critical role in identifying unexplored opportunities (Tang et al., 2012; Valliere, 2013a) while simultaneously allocating multiple resources to develop those opportunities and bring new products to life (Li et al., 2013; Van de Ven, 1986).

CEOs vary in their cognitive abilities and characteristics, and these variations prompt them to engage in the detection and development of NPI very differently (Eggers and Kaplan, 2009; Kaplan, 2008; Kiss and Barr, 2017; Yadav et al., 2007). For example, prior research has found that CEOs who are better at information processing influence faster implementation of NPI development strategy (Kiss and Barr, 2017) and their future focus is positively associated with higher rates of NPI (Nadkarni and Chen, 2014; Yadav et al., 2007). In this study, we propose that one reason for a differential rate of NPI is the CEOs' differential ability to continuously detect external stimuli related to novel opportunities, that is, their alertness and be able to engage in focused, deliberate actions towards resource allocation, that is, their attention. We now develop specific hypotheses arguing how, through distinct mechanisms, CEO alertness and CEO attention can influence a firm's rate of new product introduction both independently and jointly. Our conceptual model is summarized below in Fig. 1.

4. Hypotheses development

4.1. CEO attention and new product introduction

New product introduction begins with the launch of a product in the market and it results from a successful product development process that involves converting an idea into an actual product (Yadav et al., 2007). We focus first on CEO attention as our baseline case, since in the context of large firms, prior research has shown that CEO attention influences new product introduction (Li et al.,

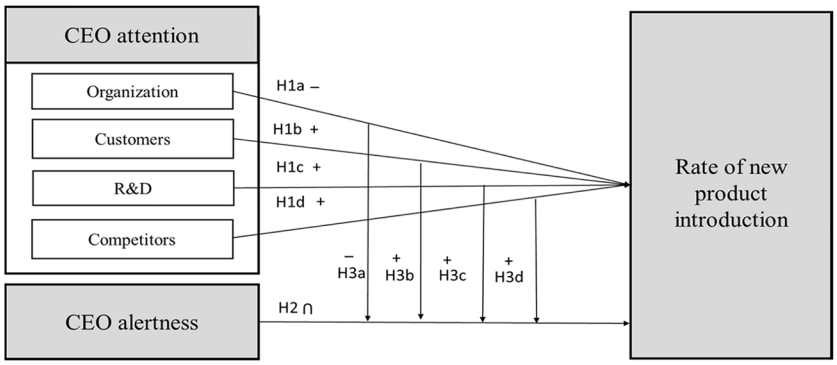


Fig. 1. CEO Attention and Alertness on Rate of New Product Introduction.

2013; Nadkarni and Chen, 2014; Yadav et al., 2007). Building on this literature stream (Cho and Hambrick, 2006; Li et al., 2013; Nadkarni and Chen, 2014; Plambeck, 2012), we argue that CEO attention, particularly in the case of SMEs, impacts the rate of new product introduction in three important ways: i) by deciding organizational priorities, ii) by determining allocation of resources to those priorities, and iii) by driving attention of employees to the identified organizational priorities. Since new product development involves resource commitments, determination of right organizational priorities has a significant bearing on the likelihood of a new product's launch. Those matters that draw CEO attention are likely to get higher priority (Stevens et al., 2015; Surroca et al., 2016). Since SMEs are often resource constrained, CEO attention determines whether a new product development is initiated and if so, whether it receives the necessary resources. CEO attention also plays a significant role in channeling the attention of employees. The communications and actions of a CEO reflect the focus of his attention, which in turn can direct employees' attention to those issues, hence creating an organization-wide attention (Luo et al., 2014).

Based on these core arguments, we now focus on CEO attention related to four important aspects of the firm that are critical to an effective new product development: organization, R&D, customers, and competitors. CEO attention to organization entails focus on employee related issues (Eggers and Kaplan, 2009; Lee and Miller, 1999) and day-to-day organizational activities. CEO attention to R &D is the focus on issues related to initiating new product ideas and developing new technology (Eggers and Kaplan, 2009). CEO attention to customers involves utilizing customer feedback related to firm's current products and new product development (Luo et al., 2014). CEO attention to competitors reflects the extent to which a CEO receives competitor-related information, something that may have an important bearing on the new product development and launch decisions (Homburg et al., 2007).

We argue that as a CEO pays more attention to matters related to employees, it takes the firm's focus away from new product development initiatives. At SMEs, the CEO often has a small top management team, so getting bogged down by internal issues means paying less attention to more critical issues. From a new product development perspective, this adversely affects organizational priorities, distorting resource allocation as well as employee attention. Employees focus their attention on issues that they believe their CEO considers more important. Further, as CEOs engage more into internal issues and increase their reliance on internal sources, they get into the trap of receiving communication pertaining more to their own firm (Luo et al., 2014). In addition, the employees may also suppress any negative feedback related to the firm. Prior literature has shown that employees have very little incentive to report customer dissatisfaction and complaints to the CEO given its adverse impact on employees' own performance appraisals (Luo et al., 2014). Thus, more internally focused CEOs may be unaware of outside changes, especially those reflecting customer preferences and feedbacks, and be slower to respond to changing industry demands (Yadav et al., 2007). Accordingly, we hypothesize:

Hypothesis 1a. As the level of CEO attention to organization increases, the rate of new product introduction decreases.

We further argue that CEO's attention to customers leads to a higher rate of new product introduction. Prior research has found that organizations with higher market orientation, that is, paying higher priorities to creation and maintenance of superior customer value, realize enhanced firm performance (Zhou et al., 2008). A CEO's active involvement in utilizing diverse customer feedback and acquiring customers' perception on product quality keeps the firm ready to address any changing customer needs (Luo et al., 2014; Rust et al., 2002). The information drawn from customer feedback and customer satisfaction helps the CEO in prioritizing and streamlining new product development plans (Fuchs and Schreier, 2011). This is particularly valuable to SMEs who are resource constrained and not able to pursue multiple new product development initiatives simultaneously. Therefore, choosing the right initiatives and ensuring their success is very critical for SMEs. CEOs' interaction with lead users, customers who face the need for new solutions earlier than others, could provide valuable information about new product ideas that can be developed to cater to future needs. As the CEO is aware of the changing customer demands, he/she will be able to understand that the existing product lines may get obsolete sooner, placing more importance on the new product introduction. Consequently, the CEO increases the focus on new product development initiatives to meet customer demands more effectively. Thus, we hypothesize:

Hypothesis 1b. As the level of CEO attention to customers increases, the rate of new product introduction increases.

Next, we argue that CEO's attention to research and development activities enhances rate of new product introduction. The R&D

group or unit is primarily concerned with generating new technological knowledge and applying it to develop new products. The extent of organizational resource support fundamentally impacts the unit's ability to identify valuable new product ideas and convert those ideas into actual products. Greater CEO attention to R&D translates into greater resource support for R&D activities, which enables the department to take more new product development initiatives and pursue more intently the initiatives already undertaken (McMillan et al., 2003). Prior studies have shown that firm's focus on product pipeline, strong R&D team, and resource availability is positively associated with the speed of new product development (Kessler and Chakrabarti, 1999; McMillan et al., 2003). CEO attention to R&D will be instrumental in selecting teams to develop ideas, technology and prioritizing resource allocation. As a CEO increases attention to R&D, he or she gets actively involved in screening the quality of new product development ideas, planning initiatives and more directly monitoring the progress of new product development projects (Barker III and Mueller, 2002).

The efficient utilization of R&D investments is of particular importance to SMEs, as the development of new products is quite resource intensive and complex. Further, timely completion of new product development projects is also central in increasing the rate of new product introduction. Many new product initiatives never make it to commercial launch as too much time is consumed in the development process, delaying their potential entry to the marketplace. With CEO's increased attention to R&D, employees also increase their attention to R&D related activities. Together, such attention to R&D leads to identification of more useful ideas, a greater conversion rate of ideas into potential products, a more efficient utilization of existing R&D investments, and a faster new product development cycle. Therefore, we propose:

Hypothesis 1c. As the level of CEO attention to R&D increases, the rate of new product introduction increases.

Finally, we argue that CEO attention to competitors will positively influence new product introductions and enable the firm to comprehend the competitive landscape in which it operates (Marcel et al., 2011). Gaining information on competitors will enhance the awareness of the new technological developments and anticipated changes. Prior research has found that businesses that adapt to new technological developments as done by their competitors, have better product innovations (Turner et al., 2010). As the CEO pays attention to the competitors, the firm will be aware of the product and technological strategies adopted by the firm's competitors, which will help the firm decide on the type and number of products to launch. In addition, it will also direct CEO's focus on prioritizing organizational resources to be directed towards particularly important product development initiatives. Since SMEs are resource constrained, CEOs' focus on competitors will help them decide and prioritize which product development initiatives need to be pursued first. Moreover, a better informed CEO will drive the firm to streamline its own product development strategies in order to remain competitive. Prior research suggests that firms that are able to align their own innovation strategy with that of their competitors are better able to tackle the competitive landscape (Turner et al., 2010). CEO attention to competitors will not only help the firm adapt a sense of urgency when it comes to introducing new products, but also enable the firm to organize existing resources towards developing that product. Thus, we propose that.

Hypothesis 1d. As the level of CEO attention to competitors increases, the rate of new product introduction increases.

4.2. CEO Alertness and new product introduction

The key to a successful new product development process is the emergence of something new or novel (Witt, 2009) and implementation of creative ideas (Im and Workman, 2004). On one hand, the identification of novel information and knowledge is a key input to new product development (Katila and Ahuja, 2002; Maggitti et al., 2013), and on the other hand, creative ideas are the starting point of any product innovation (Im and Workman, 2004). According to discovery perspective, alertness, the ability of the decision makers that helps spotting unidentified opportunities from the external environment, is key in discovering something new or novel (Gaglio and Katz, 2001; Kirzner, 1997). Since it gets shaped through prior experience and entrepreneurial schemata, decision makers who are alert will be able to utilize information from external stimuli in creative ways (Valliere, 2013b). A highly alert CEO will acquire new information that will enable faster new product development. Based on prior literature, we identify two core mechanisms through which alertness supports new product introduction (Kirzner, 1997, 1999; McCaffrey, 2014). First, alertness enables the CEO to identify opportunities in the environment through diverse and novel information acquisition (Gaglio and Katz, 2001; Huber, 1991). The availability of diverse and novel information enhances CEO's ability to combine his existing knowledge in new ways. Prior research has found that the rate of new product introduction is a function of CEO's ability to combine new knowledge with existing knowledge (Smith et al., 2005). Such novel information will enable the CEO to develop new ideas and ultimately allocate and coordinate resources to lead innovation efforts better.

Second, alertness to opportunities prepares entrepreneurs to be creative (Ko and Butler, 2007). Kirzner (1999) suggested that alertness must include entrepreneur's perception of the way in which creative and imaginative action will take place. Scholars have argued that alertness is positively related to entrepreneurial creativity due to its higher sensitivity to opportunity stimulus that enables the person to gather more information than usual and link it to what is contained in the memory in creative ways (Kirzner, 1999; Ko and Butler, 2007; Tang et al., 2012). Further, empirical evidence suggests that creativity positively influences new product development by adding novelty and meaningfulness (Im and Workman, 2004). We argue that alertness will influence new product development by gathering novel information and creatively combining it with existing information. Combining these two mechanisms, we argue that CEO alertness helps identify and creatively shape opportunities. For SMEs that often function under resource constraints, an alert CEO will be instrumental in identifying new opportunities from external environment and in creatively managing existing resources. In general, alertness, which enables CEOs to acquire novel information from external environment, identify opportunities, and stimulate creativity in shaping ideas, will help achieve higher rate of new product introductions.

Prior literature suggests that some entrepreneurs are able to discover more opportunities than others and this difference could be attributable to their level of alertness (Gaglio and Katz, 2001; Kirzner, 1997). Accordingly, the decision makers could possess varying level of alertness. A state of high alertness might be defined as a condition involving enhanced ability to detect even the slightest environmental stimuli (Oken et al., 2006; Posner and Petersen, 1990). It is like a sensitive radar designed to detect even the faintest signal. Therefore, where CEOs in the state of alertness generally will be able to spot unidentified opportunities, in a state of high alertness they will be very sensitive to many opportunities capturing both more meaningful and less meaningful ones. Although prior literature has argued that the effect of alertness will be positive on firm innovation (Tang et al., 2012) and venture success (Amato et al., 2017), we argue that a high level of alertness may not be as helpful to decision makers.

We argue that high alertness will hurt the new product introduction process for two reasons: i) information overload and, ii) the crowding effect. *First*, information overload occurs when decision makers, especially the CEO, face a large volume of information in a short period of time (O'Reilly III, 1980; Van Knippenberg et al., 2015). Prior literature suggests that information overload overwhelms CEOs resulting in poor performance (Madhavan and Prescott, 1995; O'Reilly III, 1980). We further argue that, information overload will lead to organizational confusion and exacerbate cognitive overload for the CEOs (Kirsh, 2000). As alertness is related to exposure to a wide variety of novel information (Kirzner, 1997), in a state of high alertness, CEOs will be exposed to too many varieties of information. But their cognitive limitations will make it difficult to assimilate and effectively process that information beyond a certain point. When CEOs encounter too many new ideas at once, they may find it hard to separate good ideas from the rest. Thus, a high level of alertness will make it difficult to remain engaged and exploit the most promising opportunity in a dedicated manner. Further, due to potentially limited cognitive abilities, CEOs will lose sight of organizational priorities, as a result, even the new product initiatives that have been already undertaken will suffer. Consequently, the firm's rate of new product introduction is likely to get adversely affected.

Second, CEO's high alertness brings too many opportunities for the firm to pursue resulting in crowding effect. Crowding effect will occur due to excess accumulation of opportunities. “Crowding out” is the competitive situation where one option exerts competitive pressure over the other when density is high (Xu et al., 2014), resulting in either elimination of the weaker option or questioning the viability (survival) of all options (Burke and van Stel, 2014). Since SMEs have limited internal resources, and the process of developing new products is complex and resource intensive (Maggitti et al., 2013), firms find it difficult to pursue so many opportunities. The complexity of new product development and diversity of knowledge elements will make it difficult to realize all perceived opportunities and develop new products. More critically, as a CEO identifies too many new opportunities and pushes the firm to chase those, due to resource constraints the firm may not be able to translate those opportunities into positive outcomes. Too many product development projects being pursued at the same time will hurt each other because of the availability of limited resources. It could potentially lead to more ‘half-baked’ efforts that would be costly and counterproductive. In order to pursue a new project, resources will have to be pulled out from other ongoing projects, and as this process continues, it can delay almost all of the projects (Wheelwright and Clark, 1992). Theoretically, in a typical crowding effect scenario, it is possible that when a firm undertakes too many new product development projects, and tries to get them out of the door at the same time, only few of those projects would get out in time (Sorenson, 2000). Accordingly, we suggest that CEO alertness increases the rate of new product introduction. However, when alertness is high, it will hurt the rate of new product development; that is, after a point, increasing CEO alertness will become counterproductive to new product introductions.

Therefore, we hypothesize:

Hypothesis 2. The relationship between CEO alertness and new product introduction is curvilinear (inverted U-shaped) with the highest new product introduction occurring at an intermediate level of alertness.

4.3. Joint effects of Alertness and attention

Based on prior literature on behavioral strategy and entrepreneurship, we argued above that CEO attention and CEO alertness will independently influence new product introductions. We further argue that CEO attention will moderate the relationship between CEO alertness and new product introductions.

4.3.1. CEO attention to organization and CEO alertness

While an alert CEO will acquire information from the external environment that will help develop new ideas (Amato et al., 2017; Kirzner, 1997; McCaffrey, 2014), CEO's greater attention to organization will restrain him/her from working on the new ideas further. CEOs' emphasis on organization will lead to allocating resources towards activities that are internal to the firm (Rust et al., 2002) and hence taking away the resources that could have been spent on innovation related activities. Although CEO attention that is geared towards employees leads to efficiency building, it requires resources and is usually built around standard organizational day-to-day activities. Large firms that possess slack resources are able to spend a portion of it on employee development; however, SMEs who are already resource constrained, cannot afford to allocate resources to organizational issues. In this situation, any diversion of resources other than related to new product development will exacerbate the crowding effect. So, CEO attention to organization not only will take the time away from CEO but also disturb the resource allocation plans for efforts that are geared towards new product development. As CEO alertness and CEO attention to organization simultaneously increase, it creates a growing misalignment between focus on developing new ideas and focus on employee related issues.

Although researchers have argued that organizational commitment to its employees' wellbeing improves firm performance (Lee and Miller, 1999), the CEO's involvement in day- to-day activities takes his focus away from long-term issues and distort

organizational priorities. In addition, organizational activities will increase cognitive overload (Kirsh, 2000) and hence, the ideas brought in from external environment will remain underutilized. If the CEO is trying to exploit the ideas from external environment but instead of driving the firm with an idea, is driven by the firm then it will hamper the product development process and hence will have fewer new product introductions. Thus, we hypothesize that:

Hypothesis 3a. CEO attention to organization moderates the curvilinear relationship between CEO alertness and new product introduction such that at higher level of alertness, CEOs with lesser attention to organization will achieve higher rate of new product introductions than CEOs with higher attention to organization.

4.3.2. CEO attention to customers and CEO alertness

When higher alertness leads to identification of multiple opportunities, CEOs may be motivated to develop multiple ideas at the same time. Attention to customers helps CEOs identify and focus on the most relevant opportunities. Customers play an important role in shaping the new product introduction process (Ernst et al., 2011; Fuchs and Schreier, 2011). Attention to customers will equip the CEO with knowledge about the changing product trends, improving existing products and future predictions (Luo et al., 2014). This will allow the CEO to make a decision on which product idea needs to be developed first and how it can be operationalized with maximum efficiency. The CEO will also be aware of the resource allocation plans to support product development. This will reduce the impact of any crowding effect generated by high alertness and allow the new product ideas to be fully developed and economically sustainable. In addition, attention to customers will help CEOs to focus on future market needs and customers trends while developing opportunities that have not been identified by others.

Prior research suggests that customer feedback obtained from the lead users are valuable in terms of deciding the commercial viability of the new product ideas (Ernst et al., 2011). Although high alertness will create information overload, customer feedback will enable the CEOs to prioritize their choices in identifying key opportunities and pursue them further. Overall, the CEO attention to customer will help the CEO work with resource constraints while developing targeted products and mitigate the negative impact of alertness on new product development. Thus,

Hypothesis 3b. CEO attention to customers moderates the curvilinear relationship between CEO alertness and new product introduction such that at higher level of alertness, CEOs with higher attention to customers will achieve higher rate of new product introductions than CEOs with lower attention to customers.

4.3.3. CEO attention to R&D and CEO alertness

We argue that CEO alertness and CEO attention to R&D complement each other, and together increase the rate of new product introduction. CEO attention to R&D brings a sense of purpose and urgency to the product development process. With CEO's increased attention to R&D, the R&D department enhances its intensity of technological development and new product initiation, which in turn, contributes to development of firm level capability for exploiting new opportunities (Cho and Hambrick, 2006). Improved technological capability will enable the firm to develop multiple products simultaneously and hence reduce the crowding effect in a meaningful way. While alertness contributes to bringing in new opportunities, CEO's specific attention to technology development enhances the firm's execution capability by deciding product pipelines. Attention to technology also helps in achieving organizational priorities, which would mitigate the negative effects of too many opportunities being brought in due to high CEO alertness. Moreover, as a highly capable R&D department is prepared to handle any anticipated technological changes, it takes the load off of the CEO (McMillan et al., 2003) and reducing information overload for the CEO. Therefore, CEO alertness and CEO attention to R&D will complement each other and help the firm expedite the introduction or development of new products (Ghosh et al., 2013). Thus, we hypothesize:

Hypothesis 3c. CEO attention to R&D moderates the curvilinear relationship between CEO alertness and new product introduction such that at higher level of alertness, CEOs with higher attention to R&D will achieve higher rate of new product introductions than CEOs with lower attention to R&D.

4.3.4. CEO attention to competitors and CEO alertness

CEO attention to competitors equips the decision maker with the knowledge about a competitor's strategy and helps them decide which opportunity to pursue in order to counter a competitor's strategies effectively (Marcel et al., 2011). In order to remain competitive and exploit the full potential of the identified opportunities, CEOs need to know their competitors' moves and how to counter those (Marcel et al., 2011). The firms that fail to adapt to competitors' strategies often face severe performance consequences (Boyd and Bresser, 2008). High alertness that enables the CEO to identify multiple opportunities by acquiring novel information may encourage the CEO to pursue several opportunities at the same time, leading to crowding effect. However, if the CEOs are attentive, they can channelize their resources to develop the products that counter competitors' strategy and complement their own market position. This in turn will mitigate the crowding effect and help SMEs to become more efficient and focus on their new product development. In addition, CEOs will also become aware of the competitors' product time line and accordingly decide which product needs to be introduced by their firm first (Turner et al., 2010). This will result in faster new product introduction.

Further, in order to minimize the information overload caused due to high alertness, attention to competitors allows the CEO to choose the most relevant information from a variety of information received. Prior research has also shown that firms often build and launch a portfolio of related products as a rapid response rapidly to a competitor's plans (Rothaermel et al., 2006). Hence, attention to

competitors will ease the cognitive overload by enhancing the efficiency of the information processing capability. In sum, while alertness will help the CEO acquire new opportunities and combine them with existing knowledge, attention to competitors will prepare the CEO to decide which opportunity is the best to tackle competitors' strategy. Thus,

Hypothesis 3d. CEO attention to competitors moderates the curvilinear relationship between CEO alertness and new product introduction such that at higher level of alertness, CEOs with higher attention to competitors will achieve higher rate of new product introductions than CEOs with lower attention to competitors.

5. Method

5.1. Data and sample

We tested our hypotheses using a longitudinal sample of 271 US-based public SMEs during 2004–2015. Consistent with the US Small Business Administration's (www.sba.gov/faqs) definition of a small firm, we define SMEs as firms with less than 500 employees. We used Compustat to create our sample of SMEs and employed the following selection criteria to include a firm from Compustat in our sample: i) the firm must have less than 500 employees, ii) the firm must have existed for at least five years during 2004–2015, iii) the firm must not be a service-firm, and iv) the firm had no CEO change during the observation period. We did not include private firms in our sample and we dropped those firms that were listed in Compustat for less than five years during 2004–2015, on the assumption that it would be hard to get financial and new product introduction information about such firms (Li et al., 2013; Nadkarni and Chen, 2014). Since it is difficult to measure new product introductions for service firms (Nadkarni and Chen, 2014; Nerkar and Roberts, 2004), we restricted our sample to non-service firms and accordingly excluded those firms with SIC codes between 60 and 69. Further, following Nadkarni and Chen (2014) we included only those firms that had no CEO changes during our observation period, as such changes could result in a significant change in CEO attention measures. Since we could not access and avail annual reports and did not have information for all the years, our final sample size resulted in 271 firms. This sample covers a broad range of industries and consists of firms coming from the major economic sectors, including manufacturing durables and nondurables, transportation, electronics, computers, and electronic product manufacturing (NAICS industry code = 334), chemical manufacturing (NAICS = 325), food manufacturing (NAICS = 311), utilities (NAICS = 221), merchant wholesales, durable goods (NAICS = 423), among others.

5.2. Data source for CEO attention and CEO alertness

Since CEO attention and CEO alertness are managerial cognition level constructs that are difficult to observe directly, we considered several alternative possibilities to measure them. Using surveys and interviews was one potential option. However, as we have a longitudinal sample of firms (from 2004 to 2015) and we needed yearly measurements of these variables, the options of survey and interviews was not viable. Probing CEOs' thinking at different points in time spanning about 11 years by asking questions to them would introduce bias in the measurement since they may not be able to recall their thinking at those times accurately. Also, CEOs are often susceptible to social desirability bias, hypothesis guessing and researcher's expectations (Chatterjee and Hambrick, 2007). In addition, CEOs of public companies are often reluctant to participate in survey related research, which leads to low response rates potentially introducing non-response bias (Cycyota and Harrison, 2006). Given these difficulties in measuring managerial cognition, prior research has now developed a rich tradition of using archival sources particularly those related to corporate communication to measure managerial cognition (Chatterjee and Hambrick, 2007; Nadkarni and Chen, 2014; Yadav et al., 2007).

Corporate communication documents, such as letters to shareholders (LTS), 10-K annual reports, and press releases, provide researchers with an opportunity to analyze over a long period recurring and persistent patterns of relevant attributes related to managerial cognition, especially to CEOs (Chatterjee and Hambrick, 2007; Li, 2010; Li et al., 2013). These documents are thoroughly scrutinized by the firm and are personally reviewed by CEOs, and accordingly, as prior literature has argued, they can become a vital source for measuring CEO cognition (Chatterjee and Hambrick, 2007). Moreover, the sample of our study are SMEs, where the size of the top management team is small, assures us that CEO will be actively involved in crafting the public documents. Statements in these documents also correspond to firms' actions. After examining the link between the text of annual reports and firms' investment patterns, prior researchers conclude that ‘words’ and ‘deeds’ are related (Devinney and Kabanoff, 1999) (p.61). Prior literature has extensively used corporate communication documents including LTS and 10-K filings to analyze managerial cognition (Barr, 1998; Li et al., 2013; Nadkarni and Chen, 2014). These documents represent more of managers' sensemaking processes than their impression management efforts (Clapham and Schwenk, 1991), and they may even offer opportunities to capture subconscious cognitive processes (Barr, 1998; Li, 2010).

Accordingly, we use textual analysis of corporate communication documents to measure our two managerial cognition level constructs, CEO attention and CEO alertness, so that the measures would not be dependent on CEOs' memory. We use LTS to measure CEO attention to organization, R&D, customers and competitors, and CEO alertness. A LTS is a CEO's public address of major priorities and events that are important to firms and have been used extensively in CEO's cognitive attribution related studies (Li et al., 2013; Nadkarni and Chen, 2014; Yadav et al., 2007). As such, prior literature has found LTS as highly reliable sources of information and has suggested significant CEO involvement and attention to accuracy in preparation of these documents (Chatterjee and Hambrick, 2007; Nadkarni and Narayanan, 2007). Therefore, the firm level documents such as LTS could be potentially used as alternative sources of information for measuring CEO cognition.

5.3. Independent variables

5.3.1. CEO alertness

Using a computer aided text analysis (CATA) method we measured CEO alertness from the LTS. We obtained the LTS from companies' investor relations webpages, annualreports.com and received a few archived reports by directly contacting the firms. We read the LTS and examined the usage of words generated by the text analysis software (McKenny et al., 2012).

To enhance the construct validity of our variable 'CEO alertness', we rigorously followed the recommended steps while using the CATA method (McKenny et al., 2018; Short et al., 2010). To be consistent with our theory, we operationalize 'CEO alertness' following Kirzner's definition of alertness as content neutral. This operationalization reflects a CEO's general awareness that does not involve deliberate search actions. Therefore, following the approach used by Nadkarni and Chen (2014) and Yadav et al. (2007), we do not impose any a priori restrictions regarding specific nature of events (e.g., technological changes). This approach has the potential of eliminating tautological problems from the perspective of theory development and testing (e.g., being alert about opportunity leads to finding more opportunity). Overall, our operationalization of CEO alertness as a general, content-free measure is consistent with Kirzner's theory of alertness (Gaglio and Winter, 2017; Kirzner, 1997, 2009). Consistent with prior content analysis studies, alertness scores are normalized by the total length of the text (Eggers and Kaplan, 2009; Kaplan, 2008).

We have taken three steps to measure alertness. In the *first* step, we built a dictionary of words for measuring alertness. To build our dictionary, we relied on the definition of alertness on the literature. We started off with a list of key words that included words such as 'alertness', 'alert', 'recognize', 'aware', 'vigilant' consistent with the definition of alertness proposed by Kirzner (1997). We used the Synonym Finder (Rodale, 1978) to find synonyms of these key words and create an exhaustive and mutually exclusive word list. Two raters independently coded the unique words generated by the Synonym Finder and compared them with the theoretical definition of alertness (Short et al., 2010). We tested inter rater reliability by using kappaetc (Gwet, 2016) routine in Stata15 and achieved inter rater reliability of 0.87 demonstrating consistency across rating. One of the raters who is not in the co-author team was blind to the study's purpose. We then generated an inductive word list and reduced it by removing the generic, non-relevant (e.g. the, and, 2005, security, and check etc.) and sector specific (e.g. company, medical, automotive etc.) keywords. The words generated through this inductive procedure were added to the original word list.

In the *second* step, two coders (one of the authors and another researcher blind to the study's hypotheses) independently identified the sentences in the letters to shareholders (LTS) that represent alertness and included the key words from the dictionary of alertness. Both coders then coded how many times the words appear in the sentences in the document. Consistent with the standard of content analysis we assessed both identification of sentences to code and coding of the sentences to measure alertness. The initial level of agreement between the two coders for the identification of the sentences to be coded was 88.1%. Disagreements were examined until both coders agreed on all sentences.

We offer two examples to illustrate sentences that are representation of the presence of alertness and no alertness. For example, a sentence, which is as follows: "We are *actively* watching the ongoing changes and are *alert* to any sudden movement in the market. However, we view this as a temporary reaction to short-term market conditions and therefore remain *actively* engaged with our customers…" represents alertness. In contrast, the sentence, "We are one of 18 members of OLED-A, and we *actively* participate on its marketing and technology committees" represents a non-alert sentence. Appendix B presents further examples.

In the *third* step, we conducted a validation study. Drawing on a sample of sentences from our LTS database, we surveyed 33 current managers with 4–6 years of prior industry experience to access the degree of alertness used in the sentences. These sample sentences were identified by our coding through content analysis as signs of alertness and no-alertness. We randomized the order of presentation of sentences. Respondents read a short definition of alertness and rated the sentences from 1 to 5 (1 = no alertness, 5 = very high alertness). We found that respondents' assessments were consistent with the coding: an average score of 4.1 for sentences with high alertness and 2.1 for sentences coded as no alertness. We found a 0.81 correlation between managers' assessment of CEO alertness and our content analysis.

5.3.2. CEO attention

We measured CEO attention to organization, CEO attention to R&D, CEO attention to customers and competitors using CEO's LTS. Following the guidelines used in prior literature (Cho and Hambrick, 2006; Nadkarni and Chen, 2014; Yadav et al., 2007), we assessed attention directed towards specific firm level variables by using counts of specific type of words. A LTS is a CEO's public address of major priorities and events that are important to firms and has been used extensively in CEO's cognitive attribution related studies (Li et al., 2013; Nadkarni and Chen, 2014; Yadav et al., 2007). We built a list of words for each of the attention variables. For example, CEO attention to customers is captured though a word list that contains words such as customers, consumers, buyers, communities. We found a substantial similarity between our list of words and the list used by prior literature (Yadav et al., 2007). Using this word list, we captured the level of CEO attention to organization, R&D, customers, and competitors based on the number of times words denoting attention to organization, R&D, customers, and competitors appear in the LTS for a given year. Following prior studies, attention scores are normalized by the total length of the text (Eggers and Kaplan, 2009; Kaplan, 2008).

5.4. Dependent variable: rate of new product introduction

We measure our dependent variable, the rate of new product introduction as the total number of new products introduced by a firm in a given year during 2005–2016 following prior research (Li et al., 2013; Smith et al., 2005). In a meta-analysis, (Damanpour, 1991) found that product count is a robust measure of rate of NPI over a wide range of research settings. Accordingly, this count has

been used in several studies conducted in a wide range of industry settings, as well as multi-industry settings (Hitt et al., 1996; Smith et al., 2005). Following prior literature, we identified new product introductions based on the announcements, press-releases, and reports in newspapers, magazines and trade journals. We used Lexis-Nexis, which includes news information from over 9000 sources. We conducted the process in two steps, first, we searched for relevant articles by using the combination of keywords (e.g., "new product," "new service," "introduce," "announce," "launch," "offer," "debut," "roll out," "unveil") and the name of the firms in our sample using Nexis Uni to identify the relevant new product activities for each firm for each year (Li et al., 2013). We carefully read each article to eliminate duplicates and words used in different context and a second coder, not associated with the study, repeated the same process independently for the 10% of the sample. We tested for the interrater reliability and we had a 98.1% reliability in coding new product introductions. We triangulated this measure with the section in the annual report that mentions on new product introductions for the firms. Since prior research on new products suggests it takes about three years average for a new product development cycle to complete (Griffin, 1993; Li et al., 2013), and our predictor variables, CEO alertness and CEO attention, are at the beginning of that cycle, we measure the rate of new product development with a three-year forward lag.

5.5. Control variables

For our analysis, we included several control variables that are likely to affect the relationships among alertness, attention, and the rate of new product introductions.

5.5.1. R&D intensity

Prior research has shown that R&D intensity represents a firms' general technological capability and influences firm's innovation related activities (Katila and Ahuja, 2002). We measured R&D intensity as the ratio of a firm's R&D expense to its sales. We collected R &D and sales data from Compustat. Missing R&D expenses were obtained from annual reports.

5.5.2. Slack

Previous studies have shown that slack is an important predictor of innovation because firms with slack possibly have more financial resources or technologies (Chen, 2008; Iyer and Miller, 2008). Following prior literature (Iyer and Miller, 2008; Li et al., 2013) we measured slack as equity/debt ratio. We collected the data from Compustat.

5.5.3. Firm performance

Earlier studies have found that past firm performance is a predictor of rate of NPI (Katila and Ahuja, 2002). We measured firm performance as a logarithmic function of 3-year moving average of sales growth. We obtained the sales data from Compustat.

5.5.4. Total Assets

As a firm could potentially benefit from the assets that they possess while introducing new products (Eggers and Kaplan, 2009), we controlled for the total assets the firm possess. We obtained the total assets from Compustat.

5.5.5. CEO level variables

We controlled for CEO tenure, CEO age, CEO experience and education. CEO tenure is an important indicator of CEO motivation to engage in innovation related activity. CEOs with longer tenures introduce fewer new products than CEOs with shorter tenures (Barker III and Mueller, 2002). SMEs that are smaller in size usually do not see a higher CEO turnover. Hence, CEO tenure could be an important predictor of new product introduction in SMEs. We collected CEO related information from DEF14 filed with SEC Edgar's and also from annual reports. CEO experience could possibly shape their knowledge level and hence influence the rate of new product introduction. We measured CEO experience as number of years that they have served as a CEO either in the current firm or any other similar firms. Further, CEOs that are more educated are more able to absorb new ideas and tend to pursue more new products than less educated CEOs (Barker III and Mueller, 2002). We assessed CEO education level by using of a five-point scale 1- attended college, 2- undergraduate degree, 3- attended graduate school, 4- master's degree, 5- doctorate (Herrmann and Datta, 2002).

5.5.6. Environmental uncertainty

We controlled for environmental uncertainty. This results from changes in the environment that are difficult to predict such as volatility in the product market or financial market (Krishnan et al., 2016). Since environmental uncertainty requires speedy and responsive decisions, it is vital for new product introductions. We calculated the scores for each of the industries included in our study as the coefficient of alienation (1 – R2) of the regression of industry sales in the sample year on the industry sales of the three preceding years (Carpenter and Fredrickson, 2001). The scores range between 0 and 1. We obtained the industry sales from COMPUSTAT.

5.5.7. Industry and Time

Since we have a panel data during 2004 to 2015, we included year dummies to control for period effects. We also included industry dummy since our data has come from various industries. Following the approach of Kile and Phillips (2009), we grouped our sample firms in high technology intensity industry and low technology industry and controlled for their technological environment using high tech industry dummy variable. It is likely that high technology industries will experience a higher rates of new product introductions.

Table 1
Descriptive statistics and correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) New product Introductions $_{t+3}$	1.000													
(2) CEO alertness	0.153*	1.000												
(3) CEO attention to organization	−0.091*	−0.096*	1.000											
(4) CEO attention to R&D	0.099*	−0.054*	0.032	1.000										
(5) CEO attention to customers	0.075*	−0.067*	0.068*	0.158*	1.000									
(6) CEO attention to competitors	0.146*	−0.001	0.059*	0.323*	0.048*	1.000								
(7) R&D intensity	0.120*	0.093*	−0.022	0.041	−0.141*	−0.086*	1.000							
(8) Total assets	0.149*	0.186*	−0.022	−0.039	−0.062*	−0.044	0.053*	1.000						
(9) Slack	0.049	0.067*	−0.006	0.100*	−0.049	0.017	0.230*	0.123*	1.000					
(10) Firm Performance [a]	0.089*	0.085*	−0.003	−0.051*	0.075*	0.041	−0.551*	0.654*	−0.187*	1.000				
(11) CEO age	0.007	0.028	−0.070*	0.058*	0.022	−0.012	−0.086*	0.024	0.069*	0.040	1.000			
(12) CEO experience	0.005	0.017	−0.064*	0.028	0.013	−0.016	−0.049	0.001	0.067*	0.018	0.883*	1.000		
(13) CEO education	−0.011	−0.009	−0.010	−0.041	0.013	0.013	−0.058*	−0.032	−0.039	0.027	−0.099*	−0.057*	1.000	
(14) CEO tenure	−0.007	0.029	−0.030	0.050*	0.027	−0.049	−0.034	0.035	0.051*	0.035	0.733*	0.712*	−0.013	1.000
(15) Environmental Uncertainty	−0.025	−0.005	−0.029	−0.041	−0.067*	−0.004	−0.058*	0.014	0.118*	0.027	0.138*	0.115*	0.019	0.127*

[a] Logged values.
* $p < .1$.

Table 2A
Random-effects poisson regression estimates of rate of new product introduction (Main Effects).

Variables	Model 1	Model 2	Model 3	Model 4
	Control	CEO Attention	CEO Alertness	CEO Alertness Curvilinear
R&D intensity	0.251**	0.251**	0.242**	0.237**
Total assets	−0.061	−0.029	−0.031	−0.051
Slack	0.120	0.052	0.038	0.055
Firm Performance	0.384**	0.354**	0.337**	0.342**
High Tech Industry Dummy	0.124	0.191+	0.185	0.153
CEO Age	0.336	0.412	0.354	0.251
CEO Experience	0.068	−0.045	−0.049	0.016
CEO Education	0.002	0.070	0.046	0.022
CEO Tenure	−0.169	−0.134	−0.086	−0.116
Environmental Uncertainty	−0.035	−0.088	−0.085	−0.057
CEO Attention to Organization		−0.064**	−0.060**	−0.060**
CEO Attention to Customers		0.004	0.005	0.004
CEO Attention to R&D		0.005*	0.005*	0.004*
CEO Attention to Competitors		0.052**	0.050**	0.050**
CEO Alertness			0.103**	0.270**
CEO Alertness Square				−0.021**
Year Dummy	yes	yes	yes	yes
Constant	−3.153+	−3.332+	−3.231+	−3.047
lnalpha	−4.268*	−3.447**	−3.408**	−3.344**
Number of firms	271	271	271	271
Log likelihood	−1286.532	−1215.451	−1209.786	−1205.419
LR test		142.16**	11.33**	8.74**
Wald's chi square	106.773**	152.039**	164.605**	168.651**

+ p < .10.
* p < .05.
** p < .01.

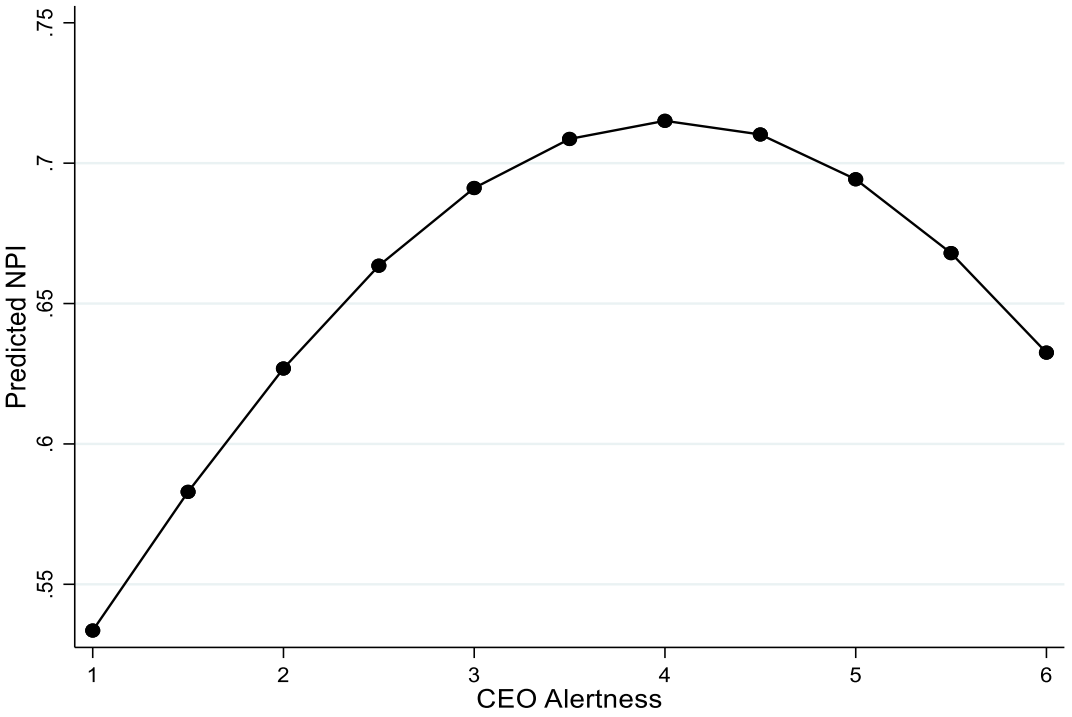


Fig. 2. CEO Alertness and Rate of New Product Introductions (Model 4).

Table 2B
Random-effects poisson regression estimates of rate of new product introduction (interaction effects).

Variables	Model 5	Model 6	Model 7	Model 8	Model 9
	Alertness X Attention to Organization	Alertness X Attention to Customers	Alertness X Attention to R&D	Alertness X Attention to Competitors	Full
R&D intensity	0.236**	0.237**	0.220**	0.229**	0.221**
Total assets	−0.050	−0.051	−0.050	−0.051	−0.057
Slack	0.050	0.055	0.041	0.052	0.052
Firm Performance	0.339**	0.344**	0.330**	0.341**	0.336**
High Tech Industry Dummy	0.154	0.155	0.156	0.159	0.128
CEO Age	0.304	0.231	0.197	0.135	0.172
CEO Experience	0.008	0.011	−0.030	0.002	−0.024
CEO Education	0.013	0.021	0.045	−0.002	0.040
CEO Tenure	−0.131	−0.109	−0.057	−0.067	−0.057
Environmental Uncertainty	−0.064	−0.051	−0.050	−0.063	−0.063
CEO Attention to Organization	−0.119**	−0.061**	−0.062**	−0.061**	−0.102**
CEO Attention to Customers	0.004	0.000	0.004	0.005	0.018+
CEO Attention to R&D	0.005+	0.006*	0.005	0.006*	0.006
CEO Attention to Competitors	0.049**	0.050**	0.045**	0.030	0.002
CEO Alertness	0.141	0.245**	0.562**	0.398**	0.341+
CEO Alertness Square	−0.006	−0.021	−0.129**	−0.083*	−0.104*
CEO Attention to Organization X CEO Alertness	0.059*				0.040
CEO Attention to Organization X CEO Alertness Square (H3a)	−0.008+				−0.007
CEO Attention to Customers X CEO Alertness		0.002			−0.014
CEO Attention to Customers X CEO Alertness Square (H3b)		0.000			0.002
CEO Attention to R&D X CEO Alertness			−0.007		−0.012+
CEO Attention to R&D X CEO Alertness Square (H3c)			0.004**		0.007*
CEO Attention to Competitors X CEO Alertness				0.002	0.045*
CEO Attention to Competitors X CEO Alertness Square (H3d)				0.004+	−0.008+
Year Dummy	Yes	Yes	Yes	Yes	Yes
Constant	−3.025	−2.936	−2.883	−2.626	−2.541
Lnalpha	−3.737**	−3.330**	−3.738**	−3.634**	−4.094*
Number of firms	271	271	271	271	271
Log likelihood	−1203.282	−1205.161	−1195.582	−1198.236	−1192.140
LR test	4.27	0.52	19.68**	14.37**	26.56**
Wald's chi square	172.296**	169.598**	194.567**	189.743**	206.788**

+ $p < .10$.
* $p < .05$.
** $p < .01$.

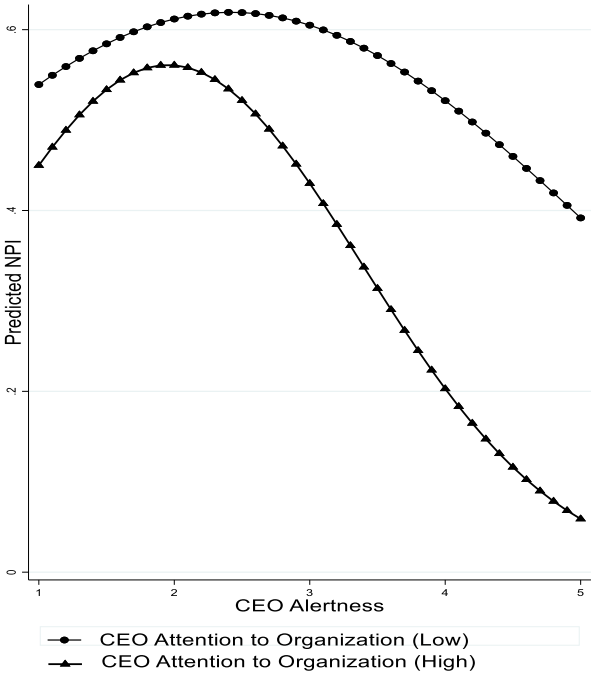
5.6. Estimation method

Our dependent variable, rate of new product introduction, is a count variable. The test for over-dispersion indicated no skewness (likelihood ratio test for the over-dispersion parameter $\alpha = 0$, $p = .251$). Thus, we used Poisson regression to model it. We used Hausman specification test to choose between fixed effects model and random effects model. As the test result for the full model showed, there was not a significant difference between fixed effects and random effects models ($\chi^2 = 16.23$, $p = .437$), we chose to use random effects model.

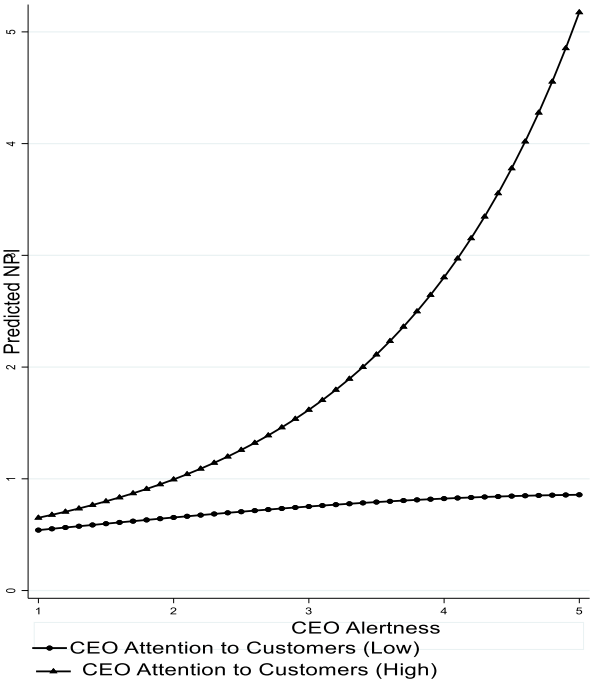
6. Results

Table 1 provides the descriptive statistics and correlations for all the study variables. The correlation between the CEO attention variables and alertness are modest. We checked for multicollinearity issues among variables using the procedure suggested by Belsley et al. (2005). Table 2A represents the results of the hypotheses tests of the independent effects of CEO attention variables and CEO alertness on the rate of new product introduction. Model 1 includes the control variables. We find that higher R&D intensity has a significant positive association with higher rate of new product introductions. Model 2 introduces attention variables including CEO attention to organization, R&D, customers, and competitors. Hypothesis 1a, 1b, 1c and 1d predict the main effects of CEO attention on new product introduction. Since the lr test indicates that each additional predictor adds significantly to the model, we interpret the results only from model 4. All predictors except CEO attention to customers are significantly predicting the new product

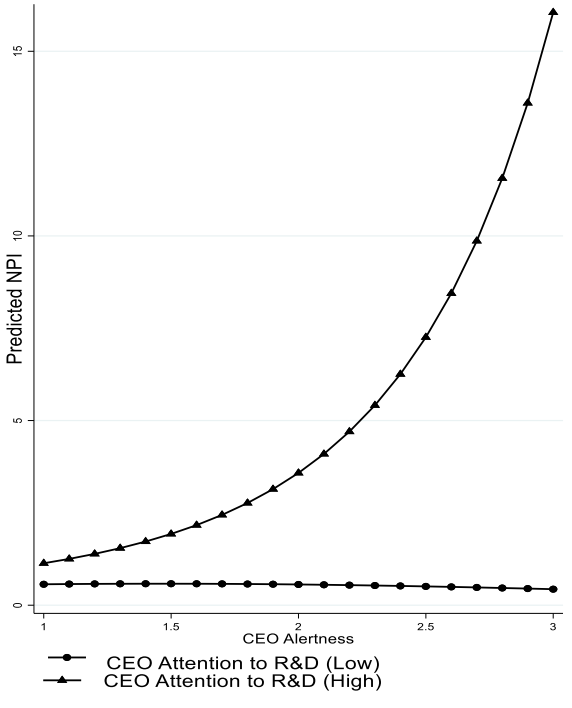
A



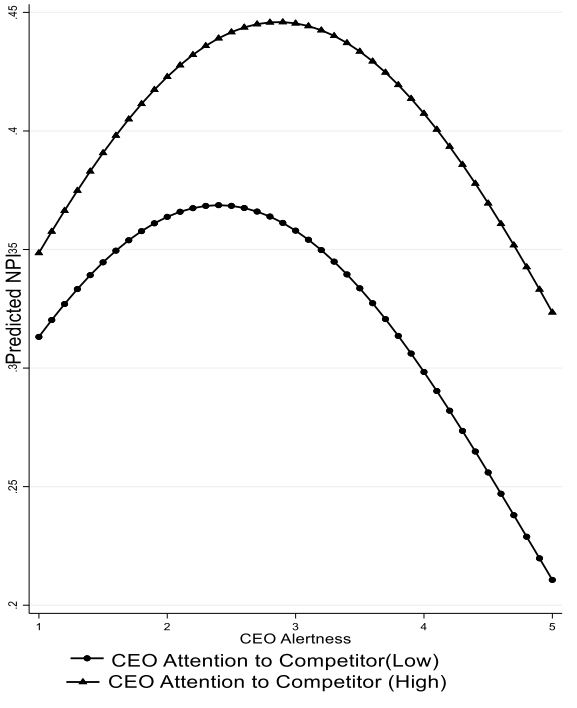
B



C



D



(caption on next page)

Fig. 3. A-Interaction Plot of CEO Alertness, CEO Attention to Organization and Rate of New Product Introductions (Model 5). B-Interaction Plot of CEO Alertness, CEO Attention to Customer and Rate of New Product Introductions (Model 6). C-Interaction Plot of CEO Alertness, CEO Attention to R&D and Rate of New Product Introductions (Model 7). D-Interaction Plot of CEO Alertness, CEO Attention to Competitors and Rate of New Product Introductions (Model 8).

Table 3
Robustness checks with distributed lag model for 1-, 2- and 3-year lags.

Model	Model 1	Model 2
Variables	CEO alertness linear	CEO alertness curvilinear
R&D intensity	0.002**	0.14**
Total assets	−0.001*	0.012
Slack	0.003*	0.004+
Firm Performance	0.150**	0.253**
High Tech Industry dummy	0.137**	0.275**
CEO age	0.002	0.008
CEO Experience	0.004	0.008
CEO Education	−0.021	−0.014
CEO Tenure	−0.006	−0.008
CEO attention to organization (t-1)	−0.003	−0.006
CEO attention to organization (t-2)	0.041**	0.043**
CEO attention to organization (t-3)	−0.084**	−0.083**
CEO attention to R&D (t-1)	−0.008	−0.007
CEO attention to R&D (t-2)	0.006	0.003
CEO attention to R&D (t-3)	0.019**	0.016**
CEO attention to customers (t-1)	−0.001	−0.001
CEO attention to customers (t-2)	0.010	0.006
CEO attention to customers (t-3)	0.007	0.008
CEO attention to competitors (t-1)	−0.023+	−0.021
CEO attention to competitors (t-2)	0.009	0.015
CEO attention to competitors (t-3)	0.036**	0.037**
CEO alertness (t-1)	−0.043+	−0.041
CEO alertness (t-2)	0.130**	0.165
CEO alertness (t-3)	0.332**	0.633**
CEO alertness square (t-1)		−0.005
CEO alertness square (t-2)		−0.165*
CEO alertness square (t-3)		−0.070**
Summed coefficients of CEO attention to organization	−0.046**	−0.041**
Summed coefficients of CEO attention to R&D	0.004+	0.005*
Summed coefficients of CEO attention to customers	0.003	0.001
Summed coefficients of CEO attention to competitors	0.022+	0.025*
Summed coefficients of CEO alertness	0.16**	0.427**
Summed coefficients of CEO alertness square		−0.072**
Year dummy	yes	yes
Constant	−2.93**	−3.64*
Log likelihood	−1396.37	−1386.85
Wald's chi square	237.61**	247.44**

+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

introductions. To compute effects on the probability of a product introduction, the coefficients should be exponentiated to obtain incidence rate ratios (IRRs). For example, a coefficient of 0.50 corresponds to an IRR of $e^{0.50} = 1.65$, which implies that a 1-unit increase in the predictor—leads to a 65% greater probability of new product introduction. We find that the main effects of CEO attention to organization ($\beta = -0.064$; $p < .01$) *[IRR = 0.94]* is negatively related to new product introduction, suggesting that as the CEO pays higher attention to his or her organization the rate of new product introductions decreases. One unit increase in CEO attention to organization would lead to an expected 6% decrease in new product introductions. Further CEO attention to R&D ($\beta = 0.005$; $p < .05$) *[IRR = 1.005]* and competitors ($\beta = 0.050$; $p < .01$) *[IRR = 1.051]* are positive and significant indicating that as CEOs focus their attention to R&D and competitors the rate of new product introductions increases. Although CEO attention to customers ($\beta = 0.004$; $p > .251$) *[IRR = 1.004]* has a positive effect on NPI, the effect is not significant. Hence, Hypotheses 1a, 1c and 1d are supported and 1b is not supported.

Table 2A, Model 4 shows the effects of alertness and alertness square. We hypothesized (in Hypothesis 2) that there is an inverted U-shape relationship between CEO alertness and the new product introductions made by a firm. To test the curvilinear relationships, we used three step procedure recommended by Haans et al. (2016). First, Model 4, indicates that the coefficient of CEO alertness is positive and significant ($\beta = 0.270$; $p < .01$) and that the squared term ($\beta = -0.021$; $p < .01$) has a negative and statistically significant relationship. Second, we calculated the slope of the curvilinear relationship both at upper bound and lower bound data points.

Following Haans et al. (2016), if the tests at both points are statistically significant and have opposing signs, we can confirm the significance of the curve. Our results indicate a statistically significant slope at both low ($t = 8.41$; $p = .000$) and high ($t = -2.85$; $p = .002$) datapoint. Finally, we calculated the Fiellar interval [2.97, 6.62] of the turning point and found that it is within the 95% of the confidence interval, that is, within the main body of the data. Fig. 2 illustrates the nature of the curvilinear relationship.

In Table 2B, we include the joint effects of CEO attention and alertness on new product introductions to test Hypotheses 3a, 3b, 3c, and 3d in Models 5–8. We hypothesized that CEO attention to organization moderates the inverted U-shaped relationship between alertness and new product introductions. Specifically, the greater the attention to organization lesser will be the rate of new products developed if the CEO is highly alert. Model 5 shows that attention to organization has a positive and significant effect ($\beta = 0.059$; $p < .05$) on alertness and new product introduction, and a significant negative effect ($\beta = -0.008$; $p < .10$) on alertness square and new product introduction. These results indicate that at higher level of alertness, CEOs that pay lesser attention to organization are able to achieve higher rate of new product introductions. We also found the turning point shift to be significant at ($t = 1.69$, $p = .045$), providing support for H3a (Haans et al., 2016). As non-linear specifications could be complicated to interpret, we graphically plotted the moderation effect in Fig. 3A, which represents the steepening moderating effect (Hoetker, 2007). The average marginal effects of the interaction is shown in Fig. B.1 A (Ai and Norton, 2003; Connelly et al., 2010). The average marginal effect of CEO attention to organization (Fig. B.1 A) is increasing at the lower level of alertness and then decreasing with increasing level of alertness. The graphs indicate that although CEO attention to organization attenuates the detrimental effect of CEO alertness, at a high level of alertness the presence of both does not help.

Model 6 shows that attention to customer has a positive effect ($\beta = 0.002$; $p > .212$) on alertness and new product introduction, and a positive effect ($\beta = 0.000$; $p > .311$) on alertness square and new product introduction. However, the effect is not significant. The joint effects of CEO attention to customers and CEO alertness are depicted in Fig. 3B. Although the interaction term is not significant, the joint effect of attention to customers and alertness indicates that the rate of new product introduction increases with high alertness and high attention to customers (Hoetker, 2007). Hoetker (2007) notes "the significance of the interaction effect cannot be determined just by the significance of the interaction coefficient. There can be a significant interaction effect for some observations even if the interaction coefficient is not significant" (pp. 336). Based on this recommendation, we further examined the turning point shift and found it to be non-significant ($t = 0.67$, $p = .251$), hence hypothesis H3b is not supported. The average marginal effects of the interaction are shown in Fig. B.1B.

Model 7 shows that attention to R&D has a negative effect ($\beta = -0.007$; $p > .15$) on alertness and new product introduction but has a significant positive effect ($\beta = 0.004$; $p < .01$) on alertness square and new product introduction. This indicates higher CEO attention to R&D positively influences the relationship between alertness and new product introductions. The joint effects of CEO attention to R&D and CEO alertness square are depicted in Fig. 3C. We also found the turning point shift to be significant ($t = 1.87$, $p = .031$), providing support for H3c. The average marginal effect curve indicates that at a state of high alertness CEO attention to R&D mitigates the hurtful effects and helps achieve higher rate of new product introductions (Fig. B.1C). Lastly, the joint effect of attention to competitors and alertness square (Model 8) is positive and significant ($\beta = 0.004$; $p < .01$). According to our arguments for hypothesis 3d the attention to competitors positively moderates the relationship between alertness and new product introductions. Our results and plots indicate that higher level of CEO attention to competitors is more beneficial when CEO alertness is at higher level. The average marginal effect of CEO attention to competitor on alertness and NPI is depicted in Fig. B.1 D.

6.1. Validation study

We examined the extent to which our alertness measure correlates with the measure developed by Tang et al. (2012). According to Tang et al. (2012) entrepreneurial alertness comprises of three dimensions including scanning and searching for new information, connecting previously disparate information, and evaluating whether the new information represents an opportunity. This conceptualization of alertness by the prior researchers has incorporated two theoretical perspectives, one, alertness is a cognitive process that enables entrepreneurs identify new information, and two, it involves entrepreneurial action of evaluating and judging the identified information. Drawing on the alertness concept introduced by Kirzner (1999), we conceptualize alertness as a radar equivalent capability of the entrepreneur to receive information continuously and faster than others. Further, based on cognitive psychology literature, we argue that alertness is not time bound, hence, alert entrepreneurs will not only be able to identify information without any time lapses but also be able to connect it to information already acquired. We expected our alertness measure to be correlated with some of the dimensions of the alertness scale developed by prior researchers. We conducted a survey of the CEOs that included measures of alertness construct taken from Tang et al. (2012). A packet containing our survey, along with a cover letter and prepaid business reply envelope, was sent to the CEO of each firm. To enhance typically low response rates among CEOs in the initial mail survey, we rigorously followed two-step process. First, we contacted the CEOs through messages sent to their LinkedIn profile and briefly informed them the purpose of our study. Second, we sent a complete survey packet over mail with a cover letter indicating our request to fill-out and return the completed surveys. Following prior studies, we promised to donate $20 for every completed survey to the charity of the CEO's choice (Fernhaber and Patel, 2012). Two follow-up reminder messages were sent with another request to complete the survey. We received responses from 62 CEOs for a response rate of 22.87%. Response rates (15–20%) are typical for mailed surveys to top executives and are comparable to other studies (Ling et al., 2008). We excluded three responses due to incomplete data. This yielded a final sample of 59 firms. We tested for nonresponse bias for early and late respondents in terms of CEO age and sales revenue. We found no significant differences. To examine the extent to which our alertness measure is correlated with the measure developed by Tang et al. (2012), we used the benchmark advocated in prior literature (Cardon et al., 2013; Scheaf et al., 2019) along with the guidelines proposed by Cohen (1988), especially for behavioral research involving self-reported

measures. These benchmarks and guidelines suggest that statistically significant correlations < 0.3 are small, correlations between 0.3 and 0.5 are 'moderate' and values greater than 0.5 are 'large' (Cohen, 1988; pp. 77–87). Our examination of the latent variable correlations shows that our alertness measure is *strongly correlated* with Tang et al.' (2012) 'scanning and search' ($r = 0.68$, $p < .001$) and 'association and connection' ($r = 0.59$, $p < .001$), and *moderately correlated* with 'evaluation and judgement' ($r = 0.46$, $p < .001$). Hence, our measure of alertness and measure used by Tang et al. (2012) are conceptually close on the 'scanning and search' and 'association and connection' dimensions.

6.2. Robustness checks

We also conducted additional analysis to check the robustness of our results. The results of log likelihood ratio test (Table 2A, B) indicate that there is a significant improvement over the previous model when we added first attentional variables, alertness and the interaction variables. We also checked for the effect of each attention variable by adding attention to organization, R&D, customers and competitors each at a time in the model. The results are consistent with results depicted in Model 2. In order to explore the robustness of the findings across alternative specifications, we estimated the models through multiple lags by adding 1-, 2- and 3-year lags (Table 3). Although the coefficients of CEO alertness and attention variables show differential effects on new product introductions in year 1, 2 and 3 lags, the net effect is consistent with the hypothesized sign of the study. Further, we bootstrapped our interaction estimates using Stata 15 and randomly generated 1000 iterations using bias-corrected and accelerated percentile method. Overall, the results (Appendix B) are consistent with the initial results.

7. Discussion

Behavioral scholars have cautioned that "until strategy theory builds stronger foundations in psychology, it will struggle to explain the facts of firm behaviors" (p.1369) (Powell et al., 2011). In this study we examine psychological microfoundations to understand how cognitive elements impact new product introductions (Devinney, 2013; Helfat and Peteraf, 2015). Drawing on the prior literature on managerial cognition (Kahneman, 1973; Ocasio, 1997; Posner and Boies, 1971) and integrating the concept of alertness drawn from entrepreneurship literature (Kirzner, 1997, 2009), this study illustrates how CEOs' ability to acquire novel information from the external environment combines with their attentional focus to internal factors to shape a key strategic firm behavior-NPI.

7.1. Implications for research

Prior research has acknowledged that, alertness, the ability to discover or sense opportunities is not distributed uniformly among individuals (Kirzner, 1997, 2009), however, there is a paucity of research on how these differing capabilities impact firm strategic behaviors, such as new product development process (Devinney, 2013; Helfat and Peteraf, 2015). Within this domain, Tang et al. (2012) developed a scale to measure alertness. The authors argued that alertness is a process that enables individuals to become aware of overlooked opportunities and take actions to pursue those. To measure the construct, Tang et al. (2012) conceptualized alertness as an entrepreneurial action that has three complementary dimensions of scanning and searching, association and connection, and evaluation and judgement. Although their study augmented our understanding of entrepreneurial alertness, it combined the cognitive ability of alertness and attention together. Our study draws upon prior literature to suggest that although related, alertness and attention are distinct concepts (Kahneman and Egan, 2011; McMullen and Shepherd, 2006; Oken et al., 2006; Valliere, 2013a, 2013b). Our theorization and empirical work on alertness extends Tang and colleagues' theory development by taking a more nuanced approach. We theorize that alertness entails discovering information and connecting those in unique ways. An alert entrepreneur will pursue all the opportunities and will not necessarily pre-select those. As such, we follow the prior conceptualization of alertness by Kirzner (1997) that was based on the reasoning that being an entrepreneur logically implies that alertness has been exercised (Kirzner, 1997; McMullen and Shepherd, 2006) and the level of alertness varies across entrepreneurs (Kirzner, 1999, 2009). Hence, while our conceptualization of alertness is similar to the scanning and search, association and connection dimensions of Tang et al., (2012), it differs on the evaluation and judgement dimension.

We argue that as new product introduction is a complex process and demands faster decision making, it requires CEOs to acquire both an uninterrupted flow of novel information and focused action in order to achieve a higher rate of new product development. Highly alert CEOs will be able to capture novel information from the external environment that has been overlooked by others. Since alertness is the ability of the CEOs that not only enables them to capture the unidentified opportunities (Kirzner, 1997) but also combine them in a creative fashion, it positively influences new product development process. We also suggest that alertness and attention need to be studied jointly because a combination of these two enable the CEO to capture stimuli originating in external environment via alertness as well as facilitate sensemaking via attention (Barnett, 2008; Ocasio, 2011; Valliere, 2013a, 2013b). For SMEs where there are fewer levels of formal structures, greater centralization and fewer organizational slack resources, CEO cognition is crucial to organizational outcomes such as NPI. On one hand, CEOs need greater alertness in order to receive external stimuli uninterrupted and faster than others, on the other hand, they need superior sensemaking to process the changes in the context of the firm and decide on the future actions. As such, we build on the premise that CEOs need both the information acquiring and sensemaking capabilities to contribute to NPI. Interestingly, while attention and alertness are distinct but related concepts (Kahneman and Egan, 2011; Oken et al., 2006; Valliere, 2013a, 2013b), both literatures have evolved independently (Kaish and Gilad, 1991; Tang et al., 2012). By fusing these two rather separate yet complementary literature streams, we offer deeper insights into the role of CEO cognition in a firm's rate of new product introductions.

Our results underscore the importance of CEO cognition in that the rate of new product introduction increases by paying more attention to R&D, customers and competitors and less to organizational issues. Contrary to the popular assumption that alertness is always beneficial (Amato et al., 2017; Tang et al., 2012), our results demonstrate how a high level of alertness hurts a firm's new product development efforts. This finding offers insights to our understanding of the optimum level of alertness (Posner and Boies, 1971). Examining the joint effects of CEO alertness and CEO attention, our results show that CEO attention to organizational matters aggravates the detrimental effects of a high level of alertness, while attention to R&D and competitors mitigate them.

Our paper makes several contributions to the existing literature. *First*, by focusing on the more specific stimuli/objects—customers, competitors, organization and R&D, and by clearly specifying the underlying mechanisms our study contributes to the NPI literature by extending the prior line of inquiry that focused on a rather broad definition of stimuli/objects in terms of external and internal environment (e.g., Nadkarni and Barr, 2008; Yadav et al., 2007). While focusing on the objects at a more aggregate level, Yadav et al. (2007) found that CEO's internal focus has negative impact on the new product introduction. Our nuanced results show that the two components of internal environment we examined—R&D and organization—have differential effects on new product introductions. CEO attention to organization has negative impact but CEO attention to R&D has positive impact on the rate of new product introduction. Our results also show that among the firm's operating environment factors, CEO attention to competitors has a significantly greater impact on the rate of new product introduction than CEO attention to the other factors (customers, R&D, and organization). Since CEO's cognitive capacity is bounded, it is highly valuable to know paying attention to which stimuli/object is most helpful in new product development process. These findings bring deeper insights into how effectiveness of attention varies with different stimuli/objects and contributes to the new product development initiatives (Nadkarni and Barr, 2008; Yadav et al., 2007) .

Second, by fusing CEO attention (Ocasio, 2011) and CEO alertness (Kirzner, 1997), the two complementary yet different cognitive capabilities of the decisions makers, we show that the interaction between CEOs' acquired novel information and attention to firm's R&D, customer and competitor related issues help SMEs attain higher new product introductions. Our findings suggest ways in which firms, especially SMEs, can more effectively tap into numerous opportunities brought by alert CEOs and direct their attention to key firm level factors. Our results also tease out an inherent tension between CEO alertness and CEO attention to organization, and to competitors. Overall, our theory which is at the nexus of attention and alertness, also broadens the scope of attention-based view of the firm and helps us understand the attentional perspective better by demonstrating how different aspects of CEO attention (System 2) focused on firm's operational environment interact with CEO alertness (System 1) that is focused on the external environment (Kahneman, 2011).

Third, we contribute to the entrepreneurship literature by theoretically developing and empirically examining the relationship between alertness and new product introduction. Following the psycholinguistic approach and using three rigorous steps, we developed an empirical measure of alertness. We validated this measure by using a survey of experienced managers as well as CEOs of SMEs. Our alertness measure strongly correlated with Tang and colleagues' 'scanning and search' and 'association and connection' dimensions but moderately correlated with 'evaluation and judgement'. As we discussed above, the correlations indicate partial conceptual similarity between the two measures of alertness. Our theory and results fully explicate the relationship between the level of alertness and the rate of new product introduction. We extend the theory of alertness (Gaglio and Winter, 2017; Kirzner, 1997, 2009) further by examining the interaction of alertness with attention variables and in the process identifying its important boundary conditions.

7.2. Implications for practice

From the viewpoint of the CEO of an SME, our results suggest that cognitive overload is common due to information overflow when a CEO is highly alert. Even though alertness helps the CEO identify opportunities that were overlooked by others, it only does so to a certain extent. We suggest that CEOs first pay attention to the factors that are crucial to innovation before allocating resources to other opportunities in order to control for and prevent a crowding effect. The implications of our study also support the fact that the CEOs are human actors with high but not unlimited cognitive capabilities (Menon, 2018). If the stakeholders expect CEOs to engage in activities related to new product development, they should be given the opportunities and leeway for remaining optimally alert to receive external stimuli, and paying attention to R&D, customers and competitors. The firm should avail the services of other officers such as human resources officer taking charge of efficiency-oriented or internal organizational issues. Finally, our results are also relevant for the entrepreneurs of start-up ventures, who are dedicated to achieving specific innovation-oriented outcomes, by emphasizing that higher alertness does not always help them, however, alertness in combination with attention help them introduce more new products.

8. Limitations and directions for future research

As with most research, the results of this study should be interpreted with consideration of several limitations. *First*, our study made an attempt to measure alertness of the key decision makers using CATA. CATA allowed us to use the data available in a naturally occurring organizational setting, such as text included in LTS, to understand the relationship among underlying constructs (McKenny et al., 2018). This also enabled us to analyze data over multiple years without engaging in biases that might distort our findings. Although we made diligent efforts to operationalize the alertness construct by integrating multiple theoretical perspectives and establishing strong reliability and validity of our archival approach, we cannot rule out the biases associated with using a secondary data and a psycholinguistic approach.

Second, we acknowledge the concerns that may arise over using LTS as a source to measure the ability of the CEOs. We also understand that it is more challenging to measure alertness as compared to attention using LTS because alertness is the ability of CEOs that enables them to discover opportunities without deliberate actions, whereas attention is a deliberate action of the CEOs. Our choice of data source was motivated by our study design and our intention to capture alertness without introducing any biases.

Survey, the prevailing scale for measuring alertness (Tang et al., 2012), was not feasible for our study due to three important reasons. First, top executives of SMEs are generally reluctant to participate in survey research, and even when they do, they do not always remember the opportunities identified in previous years. Second, although our conceptualization of alertness shares some similarity with the scale developed by Tang et al., (2012), our measure of alertness is not geared towards capturing how CEOs evaluated and judged the opportunities after discovering those. Consistent with Kirzner's (1997) theorization, we conceptualized alertness as an ability of the CEOs to discover opportunities without deliberate actions, whereas, Tang et al. (2012) have developed the theory of alertness as an entrepreneurial action. Hence, the prior scale based on survey would not be able to fully capture our alertness measure. Third, the survey measure is designed to capture cross-sectional information and hence, is not equipped to establish causal relationship between CEO alertness and new product introductions. As research on the product market cycle suggests that idea to market cycles typically span about three years (Griffin, 1993), we used three year time lag between alertness and new product introductions. As we theorize alertness as a radar equivalent capability that allows CEOs to spot opportunities continuously, archival source like LTS is better equipped to measure such capabilities of the CEOs without any retrospective bias (Fiol, 1995). Using LTS as a source also allowed us to adopt a longitudinal approach and establish a temporal separation between alertness, that is, how CEOs discovered the opportunities over the years— and new product introductions. Our theory also suggests that CEOs who are alert, will capture the signals faster than others. Since, LTS is one the most important official form of communication between the CEOs and shareholders, CEOs would like to highlight in LTS that they are alert to the changes occurring in the external environment. In order to capture how CEOs are able to discover opportunities and how that influences their subsequent new product development efforts, we used LTS as a source to measure alertness. In light of the limitation that this study, future studies may use verbal protocol analysis to record and analyze how CEOs or the decision makers respond to different environmental stimuli (Grégoire et al., 2010; Isenberg, 1986). This would arguably enable researchers to measure alertness levels of the CEOs more effectively. Researchers may also use psychological tests such as cognitive reflection test (CRT) (Frederick, 2005; Levine et al., 2017) to measure the cognitive ability of CEOs and examine how it relates to alertness levels and firms' innovation decisions.

Third, our examination of the relationship between CEO attention, CEO alertness and new product introduction are based on the assumption that CEOs play an important role in new product development process. This assumption, which would likely hold for SMEs, may not hold in industries and firms where new product development is the sole responsibility of other departments such as R&D, and CEOs may not play an important role. Again, we considered the joint effect of alertness and attention on NPI by assuming that the CEO cognition would likely impact new product development process even in a stable environment. Prior research has shown that CEO's decision-making is bounded by environmental conditions, such as, dynamism- the rate of unpredictability of changes in the environment (Kiss and Barr, 2017; Nadkarni and Barr, 2008; Nadkarni and Chen, 2014; Plambeck, 2012). Future research could investigate how the alertness and attention together impact NPI with varying levels of environment conditions. The environmental contingencies will be helpful to understand whether alertness helps or hurts the CEOs who operate in a highly uncertain industry while pursuing new product ideas.

Fourth, another tradeoff we made in this research involves our measurement of the rate of NPI.[1] We operationalized this as the number of new products that were introduced by the firm in a year. Firms may be working on several new products at the same time, some of which fail to reach the market. Thus, it is possible that developed but abandoned products may consume resources which are not captured by this study. Finally, our study is limited to only the CEOs of the small and medium size enterprises located in USA. Future research could explore how the level of alertness differs among the CEOs or entrepreneurs of various countries across the world and what institutional factors enhance or impede the impact of entrepreneurial alertness on firm level outcomes (Boudreaux et al., 2019).

9. Conclusion

In this study, we made an attempt to understand how specific firm-related factors, such as, organization, customers, R&D and competitors impact the new product introductions. In SMEs, where CEO cognition is a critical resource, focusing attention on R&D, customers and competitors while limiting attention to day-to-day organizational issues can help CEOs economize on their cognitive resources and achieve higher rate of new product introductions. We explicated that CEO alertness that is instrumental in identifying opportunities may not always help CEOs operationalize those in terms of developing new products. However, their focused attention to R&D, customers and competitors along with alertness will enable the firm to achieve a higher rate of NPI. Our research also informs the decision makers of ways in which their two different cognitive capabilities in the form of attention and alertness can potentially help them achieve a higher rate of NPI and gain competitive advantage.

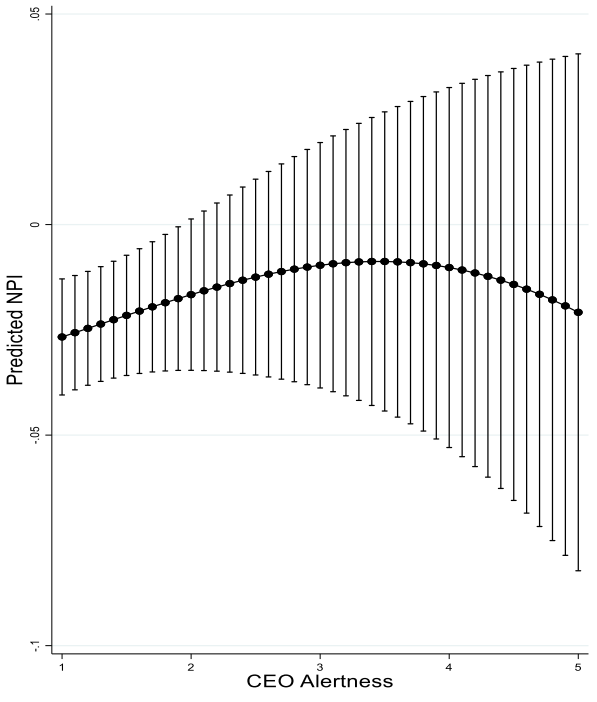
CRediT authorship contribution statement

Smita Srivastava: Conceptualization, Methodology, Software, Writing - original draft. **Arvin Sahaym:** Supervision, Writing - review & editing, Resources. **Thomas H. Allison:** Supervision.

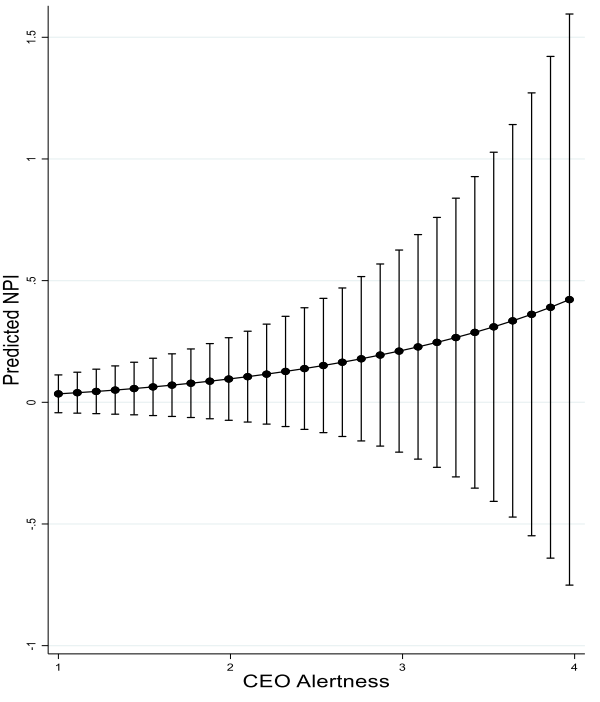
Appendix A

[1] We thank the anonymous reviewer for bringing this limitation to our attention.

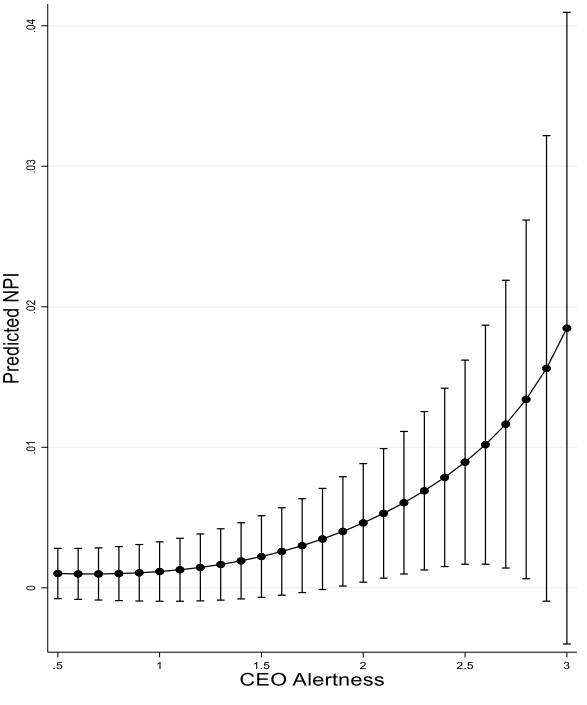
A


Predicted NPI
.05
0
-.05
-.1
1
2
3
4
5
CEO Alertness

B


Predicted NPI
1.5
1
.5
0
-.5
-1
1
2
3
4
CEO Alertness

C


Predicted NPI
.04
.03
.02
.01
0
.5
1
1.5
2
2.5
3
CEO Alertness

D

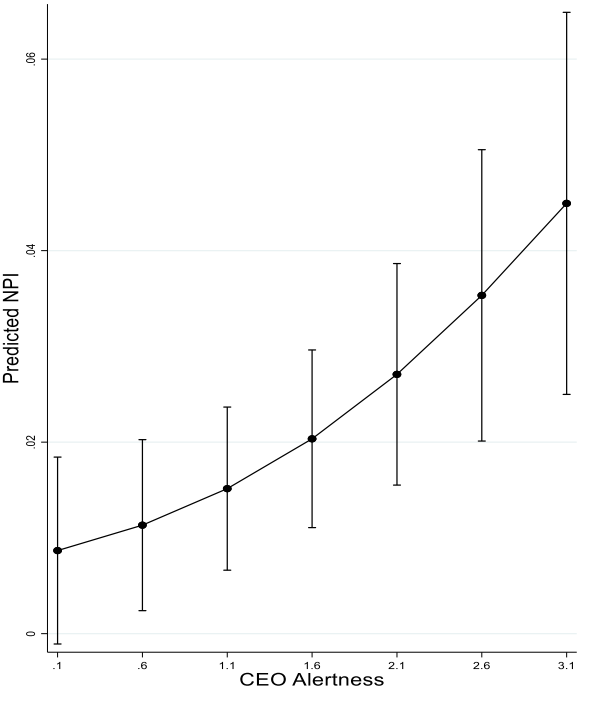

Predicted NPI
.06
.04
.02
0
.1
.6
1.1
1.6
2.1
2.6
3.1
CEO Alertness

Fig. B.1. A Average Marginal Effect of CEO attention to Organization (Model 5). B Average Marginal Effect of CEO attention to Customers (Model 6). C Average Marginal Effect of CEO attention to R&D (Model 7). D Average Marginal Effect of CEO attention to Competitors (Model 8).

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbusvent.2020.106023.

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