

**EXPLOITATIVE AND EXPLORATIVE INNOVATION IN  
SMALL AND MEDIUM SIZED ENTERPRISES:  
INDIVIDUAL AMBIDEXTARITY AND COGNITIVE  
STYLE**

**Master Thesis**

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## **ABSTRACT**

In this study, we examine the relationship between cognitive style and the extent a manager engages in exploration or exploitation activities, and a combination of both. Conducting linear regression analysis on a sample of 250 managers, we observe that the more a manager has an analytic cognitive style the more he would engage in exploitation activities. Moreover, we also found a positive relationship between a manager's analytic cognitive style and the extent he engages in both exploration and exploitation. Furthermore, results from this study show that managers with a dominant cognitive style (either intuition or analytical) are more likely to engage in exploration activities. These findings have important theoretical and managerial implications in the field of individual ambidexterity.

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## 1. INTRODUCTION

For a company to succeed over the long term, it needs to maintain a variety of innovation efforts (O'Reilly & Tushman, 1996). First, they must constantly pursue exploitative innovations; small improvements in their existing products and operations that let them operate more efficiently and deliver even greater value to customers. Additionally, firms also have to make radical new explorative innovations that profoundly alter the basis for competition in an industry, often rendering old products or ways of working obsolete. Consequently, companies are increasingly required to combine two different types of innovations; to serve the customer of today, and to serve the customer of tomorrow. He and Wong (2004) provided the first empirical evidence related to the combination of exploration and exploitation. In a study of 206 manufacturing firms they found a positive relationship between the interaction of explorative and exploitative innovation and sales growth rate. Lubatkin et al. (2006) investigated the same relationship in small and medium sized enterprises and ended up with the same conclusion: firms that combine exploration and exploitation outperform firms that solely focus on either one of those. In literature we call these firms ambidextrous.

There are several ways for a firm to become ambidextrous. Some scholars argue that a strict organizational separation is needed. In this way structural mechanisms are used to enable ambidexterity, while individuals can focus on either exploration or exploitation. On the other hand, some authors state that not organizational mechanisms are the key to ambidexterity, but individuals in the organization themselves (Gibson and Birkinshaw, 2004). Employees need to be able to take on both exploitative and explorative tasks. Literature defines this as individual ambidexterity.

In this paper we will focus on individual ambidexterity. We think that individual ambidexterity as a mechanism has an important advantage compared to organizational ambidexterity. While organizational ambidexterity requires a huge amount of resources and a large work force, individual ambidexterity is easier to implement within smaller companies with less resources and fewer employees. Therefore, the main focus of this study is on individual ambidexterity within small and medium

sized enterprises (SMEs). We want to contribute to this field of study by investigating the connection between personal characteristics and individual ambidexterity. Although previous studies provided conceptual (Gibson and Birkinshaw, 2004. O'Reilly and Tushman, 2004) and empirically (Mom et al, 2009) validated understanding about organizational factors on individual ambidexterity, the effect of personal characteristics on individual ambidexterity remains unexplored. We want to fill this gap by providing empirical evidence of the connection between individual ambidexterity and a manager's personal cognitive style. Hereby, cognitive style is labeled as a personal characteristic since it is defined as an individuals preferred way of organizing and processing information and experiences (Messinck, 1976). In this paper we use the cognitive style index of Allison and Hayes (1996) to measure this concept and investigate its relationship with exploration, exploitation and individual ambidexterity.

Based on a sample of 250 manufacturing firms, we found that the more a manager has an analytical cognitive style the more he would engage in exploitation activities. Moreover, we also found a positive relationship between a manager's analytic cognitive style and his individual ambidexterity. Furthermore, the results from this study show that managers with a dominant cognitive style (either intuition or analytic) are more likely to engage in exploration activities.

The findings of this study have implications for managers and owners in small and medium sized enterprises. First of all, the results from this study suggest that managers should have an analytical approach towards business processes if they want to combine exploration and exploitation. Hence, decisions should be fully based on analytical tools. Best practices in portfolio management, which are part of analytical decision-making, can be used to facilitate exploration and exploitation processes. Secondly, our findings also have implications for organizational HRM practices on a strategic level. Since the respondent of this study are managers or owners of small and medium sized enterprises, our results are only applicable on a strategic level, for instance in the case of placing new members in a management team. The concept of cognitive style can be incorporated within selection criteria to get the right man on the right job.

## 2. THEORETICAL FRAMEWORK

In this chapter we will elaborate more on the different concepts that we use in our paper and go in to more detail about the research that is already conducted. First of all we will introduce the concept of organizational ambidexterity and explain the different structural methods firms can apply to achieve it. Subsequently, we'll continue with the concept of individual ambidexterity. In this paragraph we will highlight the concept of individual ambidexterity and explain how our research will contribute to this field of study. Thirdly, we'll take a detour to cognitive psychology and describe the definition of cognitive style and its relevance to the research conducted in this paper. Finally, we'll dive deeper into the concept of cognitive style and investigate the different operationalizations that are described in literature.

### **Organizational ambidexterity**

Firms that are able to successfully combine exploration and exploitation are called ambidextrous. However, while empirical evidence of the relationship between ambidexterity and firm performance is provided, an effective solution of combining exploration and exploitation remains unambiguous. The problem is that explorative and exploitative innovation requires substantially different organizational structures, processes, and capabilities. In general, exploration is associated with *organic* structures, loosely coupled systems, path breaking, improvisation, autonomy and chaos, and emerging markets and technologies. On the other hand, exploitation is associated with *mechanistic* structures, tightly coupled systems, path dependence, routinization, control and bureaucracy, and stable markets and technologies (He & Wong, 2004; citing Ancona et al. 2001, Brown and Eisenhardt 1998, Lewin et al. 1999). For that reason, it is difficult for firms to pursue a new product development strategy that combines both innovation efforts. The ability to manage an appropriate balance between exploration and exploitation has been labeled as 'ambidexterity' (Tushman and O'Reilly, 1996). In the academic literature, scholars have a different view on how companies can achieve ambidexterity. One group of studies has emphasized differentiation, the subdivision of tasks into different organizational units that focus on either exploitation or exploration. For example, a business unit may become ambidextrous by creating two subdivisions with a different focus (e.g., Benner and Tushman 2003). A manufacturing plant may become ambidextrous by

creating two different teams, one in charge of exploration and another in charge of exploitation (e.g., Adler et al. 1999), and a single team may become ambidextrous by allocating different roles to each individual (e.g., Jansen et al. 2008). Processes could also be differentiated by externalizing either exploitation or exploration through outsourcing or by establishing alliances (Raisch et al. 2009). In this way an organization can completely focus on exploitation or exploration while the other effort is externalized.

The other group of studies has focused on integration, the behavioral mechanisms that enable organizations to address exploitation and exploration activities within the same unit (Raisch et al, 2009). While processes are integrated, ‘time’ could be used as the separator of the mode of working, which means that ambidexterity is dynamic instead of static. For example, the punctuated equilibrium model assumes that long periods of small, incremental change (i.e. product and/or process innovations) are interrupted by brief periods of discontinuous, radical change (Tushman & Anderson, 1986). Another example is provided by Schoonhoven & Jellinek (1990). They introduce a new organizational structure: the quasi-formal structure. Companies with a quasi-formal structure try to maintain a dynamic tension; the ability to be flexible through frequent reorganizations as well as sufficiently systematic to be efficient producers. Another way of combining exploitation and exploration is by promoting contextual ambidexterity (Gibson & Birkinshaw, 2004). Ambidexterity is static instead of dynamic, but individual employees divide their time between alignment-focused and adaptability-focused activities. In this way, organizations design business unit contexts that enable employees to pursue both types of activities. To succeed, employees themselves need to be ambidextrous. Individuals who are ambidextrous are able to engage in both exploration and exploitation activities. However, the paradox still remains: exploration and exploitation are contradicting processes and differentiating these different tasks within an individual is not possible. In our next paragraph we will elaborate on what research tells us about individual ambidexterity and which possible solutions are provided.



## **Individual ambidexterity**

Finding a solution for achieving individual ambidexterity is a hard task since managers who engage in both exploration and exploitation will face a number of challenges. They need to host contradictions, conduct multiple different tasks within a certain period of time and they have to both refine and renew their knowledge, skills, and expertise (Mom et al, 2009). But what makes an individual ambidextrous? Raisch et al. (2009) makes a distinction between organizational factors that influence an individual's ability to combine exploitation and exploration, and personal characteristics that are directly connected to an individual's ambidexterity. For example, Gibson and Birkinshaw (2004) argue that organizations should focus on just a few levers (like professional development, knowledge transfer and a more participative strategic planning process) and stick consistently to them to create an atmosphere that enables individual ambidexterity. Furthermore, they state that qualitative communication throughout the entire organization is an important virtue for individual ambidexterity. Unless lower-level employees understand the initiatives of top management, the initiatives will have a minimal impact on individual's capacity for ambidexterity. Lubatkin et al. (2006) also argues that communication is the key factor for promoting ambidexterity. They state that the top management team level of behavioral integration directly influences how its members deal with the contradictory knowledge processes that underpin the attainment of an exploitative and exploratory orientation, and that such a greater integration enhances the likelihood of jointly pursuing both. This proposition is confirmed by Mom et al. (2007) who conducted research about how the acquisition of knowledge from other persons and/or units in the same organization by a manager, influence this manager's exploration and exploitation activities. They found that top-down knowledge inflows of managers positively relate to the extent to which these managers conduct exploitation activities, while they do not relate to managers' exploration activities. Furthermore, they found that bottom-up and horizontal knowledge inflows of managers positively relate to these managers' exploration activities, while they do not relate to managers' exploitation activities. Subsequently, Mom et al. (2009) investigated the relationship between formal structural and personal coordination mechanisms on managers' ambidexterity. They found that both the participation of a manager in cross-functional

interfaces and the connectedness of a manager to other organization members positively relate to this manager's ambidexterity. Looking at all these different findings, we can conclude that communication within an organization has a positive effect on the level of ambidexterity of an individual.

However, while previous studies provided conceptual and empirically validated understanding about organizational factors on ambidexterity, the effect of personal characteristics on individual ambidexterity remains unexplored. In this paper we want to investigate the relation of cognitive style with an individual's ability to engage in exploration, exploitation and the combination of both.

### **Cognitive style**

We suspect that the way a manager organizes his information influences his ability to engage in exploration, exploitation and the combination of both. Every person has consistent individual differences in preferred ways of organizing and processing information and experience, which is defined as cognitive style (Messick, 1976). Therefore a manager's cognitive style can be marked as part of his or hers personal characteristic. In this paragraph we will give some background information about the concept of cognitive style and elaborate more on the empirical validation provided by empirical research.

Scientific interest in cognitive styles goes back at least to Jung (1923), who proposed a conceptualization of different psychological types or personalities. Later on, one of the first groups of researchers to find experimental evidence of individual differences in information processing strategies was led by Bruner et al. (1956). Their experiments were designed to investigate how individuals attempt to solve problems or learn new methods. They did so by looking at the way people identified characteristics that enabled them to discriminate between examples and non-examples of a particular concept. By observing the way subjects approached this task they identified two information-processing strategies, which they labeled focusing and scanning. Hence, they not only confirmed the existence of individual differences in information processing strategies, but also found evidence that these differences tended consistently to manifest themselves in a range of different problem solving situations (Hayes & Allison, 1994). Neurological empirical validation of the cognitive style concept comes from Glass and Riding (2000). In their study they conducted

research about individual differences in information processing related to cognitive style by recording an EEG scan during cognitive tasks. The EEG was recorded, while subjects viewed words presented at different rates. A button was pressed when a word was in a target conceptual category. They concluded that test subjects with dissimilar cognitive styles had different activities in a range of brain waves.

### **Conceptualization of cognitive style**

While the concepts of exploration, exploitation and individual ambidexterity are clear and well defined, there is still discussion about the conceptualization of cognitive style. In this section we will elaborate on the different concepts and scales that has been constructed by researchers and are applicable to this research. The goal of this section is to select the most valid and reliable concept, which we can use for generating our hypotheses in the next chapter.

The conceptualization of cognitive style varies strongly in terms of dimensions and labels. However, Riding and Cheesma (1991) argue that many of the different concepts that are developed by different researchers actually measure the same dimension. According to them, researchers put their own label on the concept of cognitive style since they conducted their research with little reference of research conducted by others. In their article they reviewed 30 different labels and found that many of the developed scales correlate. As result, the concluded that these scales could be grouped in two different dimensions: the wholist - analytic and the verbal-imagery. The two basic dimensions of cognitive style may be summarized as follows:

1. The wholist - analytical Style dimension of whether an individual tends to process information in wholes or parts.
2. The verbal - imagery Style dimension of whether an individual is inclined to represent information while thinking verbally or in mental pictures.

For measuring these constructs, Riding developed a computer presented test; the Cognitive Style Analysis (CSA). However, Riding's tool is not designed specifically for use with managers and professionals and administering the tool is time-consuming. Furthermore, Peterson et al. (2003) examined the reliability of the test and concluded that the split-half analysis of the wholist-analytic style ratio was stable (Mean  $r=0.69$ ) but the verbal-imagery style ratio is unreliable (Mean  $r=0.36$ ).

Peterson argues that responding on the verbal–imagery dimension is more varied because the verbal–imagery dimension questions are more subjective than the wholist–analytic dimension questions, and the individual differences in verbal–imagery processing are not as prevalent as the individual differences in the wholist–analytic dimension (Peterson et al, 2003). They conclude that there has been little empirical evidence (Peterson et al. quoting: Richardson’s Verbaliser-Imager, 1977; Riding & Taylor’s Verbalizer-Imagery, 1976) for the verbal–imagery dimension of cognitive style compared to the wholist–analytic style (Peterson et al. quoting: e.g. Witkin & Asch, 1948a, 1948b; Levellers and Sharpners, Holzman & Klein, 1954; Impulsivity and Reflectivity, Kagan, Rosman, Day, Albert, & Philips, 1964; Divergent-Convergent Thinking, Guilford, 1967; Holist Serialists, Pask & Scott, 1972) and therefore more research about the validity and reliability of the verbalizer-imager dimension is needed before it can be used for research purposes.

Allison and Hayes (1996) define Riding’s CSA as an important step forward in the assessment of cognitive style, but argue that the instrument is hard to measure adequately in an organizational setting. Therefore, Allison and Hayes developed the Cognitive Style Index (CSI), a new measure designed specifically for use with managerial and professional groups. This tool measures a unified bipolar scale on the wholist – analytical style dimension, based on Ornstein’s (1977) brain hemispherical research. The thought behind this dimension is that each of the two separate hemispheres in the human brain tend to specialize in different functions. The left hemisphere emphasizes a primarily linear mode of operation with information being processed sequentially, and is mainly responsible for logical thought, especially in verbal and mathematical functions. The right side of the brain specializes in the simultaneous integration of many inputs at once, and is mainly responsible for spatial orientation and the comprehension of iconic visual images (Doktor, 1978).

The terms used by Allison and Hayes to describe right brain and left brain thinking are ‘intuition’ and ‘analysis’. Intuition is processed in the right hemisphere and refers to instant judgment based on feeling and the adoption of a global perspective. People with a right brain dominancy prefer an open-ended approach to problem solving, rely on random methods of exploration, remember spatial images most easily, and work best with ideas requiring overall assessment. Analysis, on the other hand, refers to data processing based on mental step-by-step reasoning and focus on detail. Left-

brain dominant people tend to be more compliant, favor a structured approach to problem solving, depend on systematic methods of investigation, recall verbal material most readily and are especially comfortable with ideas requiring step by step analysis (Allison and Hayes, 1996).

### **3. HYPOTHESES**

#### **Managerial exploration activities**

Intuition is the kind of natural judgment process that takes place without conscious thought and generally outside any explicit awareness of the knowledge base that allows for that thought (Reber, 1993). Many scholars try to argue which added value managerial intuition could have for the total organization. Intuition is often associated with creative thought, and therefore linked with entrepreneurial behavior. Allinson and Chell (2000) state that the entrepreneur is someone whose judgment differs from that of other owner managers because he or she adopts a different approach to processing information. When making judgmental decisions entrepreneurs often find themselves in situations where there is a lack of hard facts, a great deal of complexity, and pressing time constraints. For that reason they argue that intuitive approaches to information processing offer the possibility of accommodating many of these critical aspects of entrepreneurial activity more effectively than do rational approaches. They hypothesized that entrepreneurs (who have a track record that demonstrates their ability to translate entrepreneurial intentions into entrepreneurial outcomes such as growth and capital accumulation) would be more intuitive than members of the general population of managers, in which they found a statistically significant relationship.

Armstrong and Hird (2009) also investigated the relationship between cognitive style and entrepreneurial drive. They found that the more intuitive entrepreneurs were the higher was their entrepreneurial drive compared with entrepreneurs who tended to be relatively more analytical. Furthermore, intuition has been linked to entrepreneurial opportunity identification (Mitchell, 2004), and entrepreneurial growth intentions (Dutta, 2008). Since exploration is intimately linked with entrepreneurial behavior (they both have to deal with searching for new organizational norms, routines, structures, and experimenting with new approaches towards technologies, business

processes or markets), we argue that there is also a significant relationship between intuition and exploration. Therefore we hypothesize that:

*Hypothesis 1: The more a manager has an intuitive cognitive style (or the less a manager has an analytical cognitive style), the more he or she engages in exploration activities.*

### **Managerial exploitation activities**

Analytical reasoning is marked as a structured approach for problem solving, and can therefore be linked to the extent a manager engages in organizational exploitation activities. Since the process of exploitation refines existing products or processes, thinking in detail is mandatory for success. While some scholars regard analytical thinking as slow (Evans, 2008; Stanovich, 1999) they also claim that the reflective nature of analytical thinking is less biased than intuitive thinking. Therefore, analytical reasoning is most relevant in operations and production where efficiency is an important virtue (Parikh, 1994). Shapiro and Spence (1997) further argue that analytical reasoning is most essential in situations where problems are structured. They state that the context of the problem is important in relationship to the preferred approach. Problems of a more structured nature, such as order entering, and inventory control are conducive to analytical reasoning because there are typically well-accepted decision rules. Given that the essence of exploitation activities by managers is associated with using and refining their existing knowledge, and extending existing competences, technologies, processes and products we argue that the context of the problems are of a more structured nature. Therefore we hypothesize that:

*Hypothesis 2: The more a manager has an analytical cognitive style (or the less a manager has an intuitive cognitive style), the more he or she engages in exploitation activities.*

### **Combining exploration and exploitation activities**

The dimension of cognition has traditionally been conceptualized as a dichotomy. However, many scholars argue that many styles are possible between the two ends of the poles. Hammond et al. (1987), for example, recognize a compromise form of cognitive style called quasi-rationality or 'common sense', which includes properties of both poles of the intuition-analysis dimension. Hodgkinson and et al. (2009) posit

that there is an interplay between intuition and analysis and that the ability to switch between those two is the ultimate skill in today's organizations. Blattberg and Hoch (1990) further argue that combining rational database models with managerial intuition in a 50/50 combination gives a significant better result in forecasting coupon redemption rates compared either of these decision inputs in isolation. Finally, Korthagen (2005) argues that reflection and intuition are two complementary processes that are important in learning within organizations. They claim that when reflection and intuition are keyed to one another, this contributes to a better balance within the individual and the organization. In case of individual ambidexterity, we are looking for balance and the most likely way of finding it will be if we balance our intuition with analytical thought.

*Hypothesis 3: Managers with a mixed cognitive style are more likely to engage in both exploration and exploitation activities than managers with a dominant cognitive style.*

#### **4. RESEARCH METHODOLOGY**

##### **Sample and data collection**

Data for this study were drawn from a survey of small and medium sized manufacturing enterprises based in the Netherlands. The sampling frame was constructed from the Nedsoft database, which contains a total of 703.432 companies in different economic sectors. To minimize compromising the external validity of the findings due to industry specific effects, firms were selected that operate in different manufacturing industries: textile, wood, construction, paper, plastic, metal, and software industry. Following the European definition of SMEs (EU, 2003), companies with more than 250 employees were excluded from the sample leaving 9.872 companies in the sample.

The survey was sent to each of the firms by e-mail. Prior to the mailing a pilot test was conducted on 5 companies to make sure the survey was not too long, the questions were clear and the cover letter was convincing enough to fill in the questionnaire. After some modifications to the survey due to translation errors, the questionnaire with cover up letter was sent to the CEO of the company. Since not all of the records contained e-mail addresses, only 2.523 companies were contacted.

After a week a follow-up e-mail was sent with a reminder ensuring a higher response rate. At the end we received 312 surveys corresponding with a response rate of 12,4 %. Responses with missing data as well as doubtful or contradictory answers were removed from the sample. A total of 254 valid responses were achieved at the end of the surveys, yielding a response rate of 10,1 %. Subsequently the differences between early and late respondents were compared by all variables and no significant differences were found.

## **Measures and variables**

### *Dependent variables*

Following He and Wong (2004) and Mom et al. (2009), we regard exploration and exploitation activities as two separate dimensions of activities, rather than as two ends of a bipolar scale. Since we are testing ambidextrous activities at the individual level, the scale developed by Mom et al. (2009) is the most applicable tool in this research. This scale is based on the features by which March (1991) characterized the constructs of exploration and exploitation and based on studies that illustrate managers' ambidextrous behavior in terms of exploration and exploitation related activities. To measure both dimensions Mom et al. developed seven items measuring a managers' exploration activity and seven items measuring a managers' exploitation activity. All items were measured on a five-point Likert scale ranging from 'a very small extent to 'a very large extent' of engagement in exploration or exploitation activities. We checked the scale for convergent validity by computing the cronbach alpha: 0.79 for exploration and 0.83 for exploitation Furthermore, we checked for discriminant validity by conducting confirmatory factor analysis, as shown in table 1.

- Table 1 -

By combining both scales we create a measure of ambidexterity. We used the same technique as Mom et al (2009) to calculate individual ambidexterity by computing the multiplicative interaction between the managers' exploration activities and the managers' exploitation activities. By doing so, we create a single continuum scale on which we can conduct a regression analysis. Additionally, we calculate ambidexterity by adding the exploitation activities to the exploration activities. By doing so we want to achieve a more robust statistical model.



### *Independent variable*

The Cognitive Style Index from Allison and Hayes is used to measure a manager's cognitive style. The CSI is a questionnaire, which measures cognitive style on the bipolar analytic – intuition dimension. The tool contains 38 items; each rated using a 3-point scale (true; uncertain; false). According to the authors, this overcomes the problem associated with Likert scales of five or more points that some subjects tend toward the extremes while others habitually avoid them. Examples of questions are:

‘Formal plans are more of a hindrance than a help in my work‘

‘I am most effective when my work involves a clear sequence of tasks to be performed’ ‘

‘My approach to solving a problem is to focus on one part at a time’

‘I am inclined to scan through reports rather than read them in detail’

To test the internal structure of the CSI, Allison and Hayes used a factor analysis. Since the inter-item correlations of the tool tend to be low with little variance the authors used a factor analysis of groups or ‘parcels’ of 6 items. Following the same methodology as Allison and Hayes, we grouped the different items in the same parcels to test if the CSI has a uni-factoral structure. By conducting an exploratory factor analysis (principal components method) we produced a single factor solution. According to Kline (1994, p. 95) our sample of 250 firms is large enough for confirmatory maximum likelihood factor analysis, which is shown in table 2. The chi-square value indicates that the hypothesized single factor solution is confirmed and that this accounts for over half the variance.

- Table 2 -

Table 3 summarizes descriptive statistics for the CSI as composed by data from this study, and shows that sample mean scores are generally close to the theoretical mean of 38.5. In addition to reported statistics, indices of skew (-0.02) and kurtosis (-0.34) suggest that the inventory measures a continuous variable, which is approximately normal in its distribution. To check for reliability we computed the cronbach alpha (0.77) and the guttman split half coefficient (0.77), showing both satisfactory results.

- Table 3 -

### *Control variables*

To check for any effects that may influence the dependent variable we included several control variables. Because exploration is associated with risk taking, we included the age of the respondent as a control variable. Age is connected to the extent a manager engages in risk taking activities (Vroom and Pahl, 1971); the older the manager is, the less likely he or she will show risky behavior. Increased level of education is linked with improved cognitive abilities to process information and therefore may be positively related to a managers' ambidexterity (Mom, 2009; citing Papadakis et al. 1998). In this study we take the same approach in controlling for educational effect as Mom et al. (2009). We included two dummy variables; one reflecting managers with master's degrees or higher, and another reflecting managers with bachelor's degrees, making managers with degrees below the bachelor's level the reference group. Firms that operate in a dynamic environment tend to be more innovative than firms that operate in a relatively stable environment. Therefore we included a variable measuring the environmental dynamism, controlling for any environmental factors that may influence a manager's orientation. For measuring this construct we used the four- item scale made by Jansen et al. (2006). Furthermore, the tenure in the current firm might indicate that the manager is more ambidextrous since he or she is more experienced (Mom, 2009; citing Tushman and O'Reilly, 1996). Hence, we asked the respondents how long they have been working in their current company. Finally, exploitation and exploration might differ across different industries. For that reason we included 7 separate dummy variables to test whether there were any differences between the companies in different industries. Table 4 gives an overview of the frequencies of the different industries.

- Table 4 -

## **5. ANALYSIS AND RESULTS**

Table 5 provides an overview of descriptive statistics and correlations for all variables. To test our hypotheses, we used Linear Regression analysis. Table 6 presents the results of the analyses for exploitation (models 1a and 1b), exploration (models 2a and 2b) and ambidexterity (models 3a and 3b). Models 1a, 2a and 3a are the base line models containing the control variables. Models 1b, 2b and 3b represent

the full models considering the effect of the manager's cognitive style. To discuss the results we will focus on the full models.

- Table 5 -

- Table 6 -

### **Impact of cognitive style on exploitation, exploration and ambidextrous orientation**

Based on previous studies (e.g. Allinson and Chell. 2000, Armstrong and Hird, 2009) we hypothesized that the more a manager has an intuitive cognitive style the more he would engage in exploration activities. Table 6 model 1b indicates that the relationship between cognitive style and the extent a manager engages in exploration activities is not significant when we test for a linear relationship. However, we did find a significant ( $p < 0.01$ ) U-shaped relationship between a manager's cognitive style and the extent he or she engages in exploration activities. As a result, hypothesis 1 is rejected.

As Table 4 model 2b indicates, we observed a significant positive relationship ( $p < 0.01$ ) between a manager's analytical cognitive style and the extent he or she would engage in exploitation activities. This is in line with what we hypothesized, and therefore hypothesis 2 is accepted.

We hypothesized that managers with a mixed cognitive style are more likely to engage in both exploration and exploitation activities than managers with a dominant cognitive style. Surprisingly, our data show a positive significant positive linear relationship ( $p < 0.001$ ) between a manager's analytical cognitive style and the extent he or she would engage in both exploration and exploitation activities. However, we hypothesized that this relationship would occur in an inverted U-shaped manner, instead of a linear kind. Hence, hypothesis 3 is refuted. In the next chapter, we will discuss the theoretical and managerial implications of these findings.

Furthermore, we found that the environmental dynamism correlate with the extent a manager engages in exploration, exploitation and a combination of both. These findings are in line with previous research (Mom et al, 2009), providing evidence that firms operating in a more dynamic environment are more likely to engage in

exploration activities, and less likely to engage in exploitation activities. Next to that, our data also indicates that managers operating in the metal industry are less ambidextrous than managers in the reference industry.

## 6. DISCUSSION AND CONCLUSION

In this section we will elaborate on the main findings of this paper. Subsequently, the theoretical and managerial implications will be highlighted. Finally, we will conclude with the limitations of this paper and provide suggestions for future research.

### **Main findings**

Regarding the effect of a manager's cognitive style on this manager's exploitation activities, this paper illustrates, as expected, that the more a manager has an analytical cognitive style the more he engages in exploitation activities. This indicates that analytical managers have a preference for exploitation activities, and therefore are more likely to conduct them. The nature of their inner cognitive processes is exactly in line (logic and deductive reasoning to rule out judgment, bias and variation) with the nature of exploitation activities (using and refining existing knowledge applying, improving, and extending existing competences, technologies, processes and products).

Based on previous studies we developed a hypothesis in which we stated that the more a manager has an intuitive cognitive style (or the less a manager has an analytical cognitive style), the more he or she engages in exploration activities. However, our data indicates that this relationship is u-shaped instead of linear, meaning that managers with a dominant cognitive style (either intuitive or analytic) are more likely to engage in exploration activities than managers with a mixed cognitive style. This result raises some important questions. We can account for the fact that managers who are extremely intuitive are more likely to engage in exploration activities, but the fact that managers who are extremely analytical are also more likely to engage in exploration activities is contradictory to previous research (Allinson et al, 2000; Armstrong & Hird, 2009).

This unexpected outcome could have been caused by different factors. First of all, we want to question the soundness of the mixed, compromise form of cognitive style. Some authors (Hammond et al, 1987; Korthagen, 2005) state that a mixed form

contains 'the best of both worlds', including positive aspects of both intuition and analysis. However, our data indicate that managers with a dominant cognitive style are more likely to engage in exploration activities than managers with a mixed cognitive style. It is possible that a mixed cognitive style lacks the consistency needed for full commitment in exploration activities. Intuition and analysis are both fruitful styles for exploration, but switching between modes interferes with the smooth process of decision-making. In an unpredictable environment, consistency and confidence in the final outcome is an important prerequisite for successful engagement. A mixed form of cognitive style could internally contradict decisions (the 'gut-feeling' tells something different than normative rational thought), and therefore decision-making becomes unambiguous. For example, in intuitive decision-making, new projects are selected if the manager has a 'good feeling' about it. However, if the manager uses a more thorough approach by using an analytical decision-making procedure, he or she uses objective criteria to make decision. Hence, his initial feeling about the different projects could be different compared to the selection criteria he obtained through an analytical approach. As a result, we conclude that intuition and analysis are not synergetic to each other, but combined they inflict the decision-making process.

Secondly, our data show that both intuition and analysis are successful styles for exploration. However, we hypothesized that only managers with an intuitive cognitive style would be more likely to engage in exploration activities. We think that the years of the establishment of the firm play an important mediating role when it comes to cognitive style and exploration. Start-up companies spent almost all of their time on exploration (Corbet, 2005). Since there are no standard routines and structures in the organization, decision-making could be fully based on intuition. However, as soon as a company matures, internal processes and portfolio management becomes more complex. As soon as an organization grows in terms of product diversity, analysis becomes an important tool for exploration.

Furthermore, our results show that managers with an analytical cognitive style are more likely to engage in both exploration and exploitation activities, and thus are more ambidextrous than managers with an intuitive or mixed cognitive style. Therefore, we conclude that not the mix between intuition and analysis is the preferred way of organizing and processing information, but a rational analytical

approach. We think that the complexity of balancing multiple concerns requires an analytical approach because it relates to the ability to break down complex problems into components and evaluate each component's impact. This proposition is also shown by the research of McNally et al. (2009). In their paper they describes the linkage between new product portfolio management and the role of managers' dispositional traits. They conclude that managers who exhibit a high-analytical cognitive style are more likely to use product roadmaps, and are therefore better able to balance project characteristics like time frame, technical risk, project innovativeness and resource availability.

### **Theoretical implications**

There has been an ongoing debate about the added value of analytical and intuitive decision-making tools in organizational science. Since the beginning of the era of scientific management of Frederic Taylor, analysis has been on the foreground in operational management. In other parts of the organization there has been a shift from an analytical approach to a more heuristic intuitive approach. During the 1960's strategic planning arrived on the scene, which included formalization and planning of strategic business processes. However, on a strategic level, analysis seems to be too rigid, managers are confusing real vision with the manipulation of numbers (Mintzberg, 1994). Moreover, the ongoing complexity of the environment, resulting in the increase of data required combined with less time for analysis boosted intuitive decision-making on management level. As a result, intuition gained popularity in strategic, scientific research.

In recent years there has also been an increased focus of intuition in entrepreneurial research. The main paradigm is that intuition as a decision making tool is intimately linked to entrepreneurial behavior. In our study, our findings show that both extremely intuitive and analytic managers are more likely to engage in exploration. Therefore we want to stress the importance of analytical decision-making in entrepreneurial research.

Next to exploration, this paper also investigated the impact of cognitive style on exploitation and individual ambidexterity. Companies that want to succeed on the long term need to focus on both exploration and exploitation. Yet, managers face difficulties combining exploration and exploitation activities since they have

conflicting goals and require different capabilities. Previous research shows that internal communication in the organization can help the manager to focus more on either exploration, exploitation or both (Mom et al. 2007, 2009). However, while these studies provided conceptual and empirically validated understanding about organizational factors on ambidexterity, the effect of personal characteristics on individual ambidexterity remained unexplored. In this study we have found empirical evidence about the relationship between a managers' personal cognitive style and his or hers exploration, exploitation and ambidextrous orientation. Moreover, this study differs from prior studies on individual ambidexterity in one important way. Previous studies focus' on external factors that influence a managers' individual ambidexterity. In our study, we shifted the focal point to the manager himself. By doing so, we take an inside-out approach to ambidexterity showing that personal characteristics are related to an individuals ability to combine exploration and exploitation.

Furthermore, we think our result clarifies some of the previous findings of Mom et al. (2009). In their research they hypothesized that the formalization of a manager's tasks would be negatively related to this manager's ambidexterity. However, our data did not support this hypothesis, and therefore the hypothesis was rejected. In their discussion they stated that formalized rules and procedures might also include processes for effecting change. Formalization is an important tool of analytical decision-making and therefore we argue that formalization, when used in a proper context, might facilitate individual ambidexterity

### **Managerial implications**

The findings of this study have implications for managers and owners in small and medium sized enterprises. First of all, our data suggest that managers should have an analytical approach towards business processes if they want to combine exploration and exploitation. Hence, decisions should be fully based on analytical tools. Best practices in portfolio management, which are part of analytical decision-making, can be used to facilitate exploration and exploitation processes. For example, product roadmaps and risk/reward bubble grams can offer objective criteria for making rational decisions with regard to new product development. The advantage of using an analytical approach is that decisions are based on objective criteria and not on our gut feeling. Furthermore, managers can map their cognitive style to see whether they have

a natural preference for exploitation or exploration processes. If managers are aware of their cognitive style, they can compensate their 'weakness' with regard to their explorative or exploitive orientation. Managers whose cognitive style incline towards intuitive information processing can use formal structural and personal coordination mechanisms to balance their orientation.

Secondly, our findings also have implications for organizational HRM practices on a strategic level. Since the respondent of this study are managers or owners of small and medium sized enterprises, our results are only applicable on a strategic level, for instance in the case of placing new members in a management team. The concept of cognitive style can be incorporated within selection criteria to get the right man on the right job. For instance, for overcoming the problem of managerial ambidexterity investigating an individual's cognitive style might be a good starting point. Additional HRM mechanism, like clearly defined incentives for both exploration and exploitation goals could be used to further promote individual ambidexterity. Supplemented by employee training in a broad range of skills, managers with an analytical cognitive style could become a valuable asset for companies.

### **Limitations and future research**

The first important limitation of this study concerns the measurement of cognitive style. By using a bipolar scale, intuition and analysis become mutually exclusive. Some authors suggest that intuition may be positioned as being interdependent with rational analysis rather than in opposition to it (Hodgkinson & Clarke, 2007; Hodgkinson & Sadler-Smith, 2003). Furthermore, in this paper we investigate cognitive style as a static process in the decision-making process, rather than a dynamic process with various types of cognitive styles. The ordering of the two types is also important as suggested by Shapiro and Spence (1997). They suggest that intuition should be recorded first, followed by a more thorough analytical assessment of the problem. Future research could create more insight in the process of analysis and intuition as two separate constructs on exploration and exploitation. Moreover, future research could also incorporate different time frames to the process of managers engaging in exploration, exploitation or both.

Secondly, we did not measure the years of establishment of the companies in which the respondents were working. Our data indicate that managers with a dominant



cognitive style are more likely to engage in exploration activities than managers with a mixed cognitive style. However, we can't provide any evidence in which circumstances managers should use intuitive or analytic decision-making. We think that the years of establishment play an important role; managers operating in a younger organization are more intuitive than managers in an established company. Future research could clarify this proposition by measuring the years of establishment with regard to the relationship between cognitive style and exploration.

Another limitation of this paper is that we did not account for the relationship between engagement in exploration and exploitation activities and firm performance. Our results show that analytical managers are better able to combine exploration and exploitation, but our data cannot provide any insight into the quality of the tasks performed. Although previous research shows that ambidextrous firms have a better firm performance, there is still no clarification about organizational performance with respect to individual ambidexterity. Hence, future research could provide more insight into the relationship between individual ambidexterity and individual performance with cognitive style as antecedent.

Furthermore, we limited the focus of this paper to managers of small and medium sized enterprises. Therefore, researchers need to be cautious if they want to generalize the findings of this study to senior managers of large enterprises. Processes of exploration and exploitation might be substantially different in terms of the amount of information or the level of information (Armstrong & Hird, 2009). As a result, managers in large enterprises might require a different cognitive style to combine exploration and exploitation.

Despite these limitations, we believe that this study has provided valuable insights in the personal characteristics of ambidextrous managers. We hope that our suggestions for future research and managerial implication trigger both academics and managers to dive deeper into the concept of cognitive style and individual ambidexterity.

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## APPENDIX

**Table 1: Factor analysis for Managers' Ambidexterity**

	Factors	
	1	2
To what extent did you, last year, engage in work related activities that can be characterized as follows:	1	2
<b>A manager's exploration activities (Chronbachs alpha: 0.79)</b>		
Searching for new possibilities with respect to products/services, processes, or markets	-0.31	0.64
Evaluating diverse options with respect to products/services, processes, or markets	-0.27	0.68
Focusing on strong renewal of products/services or processes	-0.25	0.65
Activities of which the associated yields or costs are currently unclear	0.04	0.65
Activities requiring quite some adaptability of you	0.12	0.62
Activities requiring you to learn new skills or knowledge	-0.02	0.71
Activities that are not (yet) clearly existing company policy	-0.16	0.61
<b>A manager's exploitation activities (Chronbachs alpha: 0.83)</b>		
Activities of which a lot of experience has been accumulated by yourself	0.72	-0.05
Activities which you carry out as if it were routine	0.75	-0.19
Activities which serve existing (internal) customers with existing services/products	0.61	-0.16
Activities of which it is clear to you how to conduct them	0.80	-0.14
Activities primarily focused on achieving short-term goals	0.46	-0.09
Activities which you can properly conduct by using your present knowledge	0.81	-0.05
Activities which clearly fit into existing company policy	0.70	0.02
<i>Extraction method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Explained Variance: 49 %</i>		

**Table 2: Factor analysis of cognitive style index item parcels**

<i>Parcel</i>	<i>Loadings</i>
1	0.58
2	0.65
3	0.67
4	0.60
5	0.51
6	0.60
Eigenvalue	3.09
Variance explained	51.43
Chi-square (df = 9)	4.53
Significance	0.87

**Table 3: Descriptive statistics of cognitive style index**

<i>N</i>	250
Mean	37.79
Median	37
Mode	32
Standard deviation	10.35
Range	52
Chronbach alpha	0.77
Skewness	-0.02
Kurtosis	-0.34

**Table 4: Industry frequencies**

<i>Industry</i>	<i>N</i>
Textile	9
Wood	14
Construction	14
Plastic	19
Metal	98
Software	28
Other	68

**Table 5: Means, Standard Deviations, Minimum and maximum values, and Correlations**

	Mean	St. dev.	Min	Max	1	2	3	4	5	6	7	8
1. Ambidexterity	10.25	2.42	2.29	18.29								
2. Exploitation	3.28	0.65	1.14	5.00	-0.58**							
3. Exploration	3.26	0.61	1.00	5.00	-0.32**	-0.32**						
4. Cognitive style	37.79	10.35	11.00	63.00	0.20**	0.20**	0.01					
5. Age	48.71	9.53	23.00	72.00	-0.09	-0.05	-0.05	0.06				
6. Tenure in firm	16.22	8.90	1.00	40.00	-0.02	0.06	-0.09	0.10	0.50**			
7. Size	2.14	1.29	1.00	6.00	0.01	0.01	-0.01	-0.06	0.04	0.13		
8. Environmental dynamism	3.30	0.84	1.00	5.00	0.15*	-0.20	0.37**	-0.09	-0.03	-0.06	0.06	
9. Education: master's or higher	0.77	0.42	0.00	1.00	0.04	-0.06	0.02	0.02	0.04	-0.14*	0.01	0.06

*N* = 250. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

**Table 6: Results of Hierarchical Regression Analysis**

	Exploration		Exploitation		Ambidexterity	
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b
<b>Main effect</b>						
Cognitive style index		0.04		0.19**		0.23***
Cognitive style index squared		0.13*		-0.03		0.06
<b>Control variables</b>						
Age	-0.02	-0.01	-0.09	-0.09	-0.10	-0.10
Education: master's	-0.04	-0.03	-0.02	-0.03	-0.05	-0.05
Tenure in firm	-0.03	-0.04	0.10	0.08	0.05	0.03
Environmental dynamism	0.37***	0.36***	-0.21***	-0.19**	0.14*	0.15*
Industry: Textile	0.01	0.01	-0.03	-0.04	-0.01	-0.03
Industry: Wood	-0.08	-0.08	-0.03	-0.04	-0.07	-0.08
Industry: Construction	0.04	0.04	-0.07	-0.08	-0.01	-0.03
Industry: Plastic	0.03	0.13	-0.11	-0.11	-0.07	-0.07
Industry: Metal	-0.05	-0.06	-0.12	-0.14	-0.16*	-0.17*
Industry: Software	0.14*	0.13	-0.13	-0.14*	-0.01	-0.03
R - squared		0.20		0.11		0.11
Adjusted R - squared		0.16		0.06		0.06

*N* = 250. \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001