

Entrepreneurial Profiling

- stimuli, reaction, action

A COGNITIVE APPROACH TO ENTREPRENEURSHIP

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1 ABSTRACT

The most recent research on entrepreneurial success has focused on identifying environmental as well as individual factors that influence entrepreneurs' behavior and outcome of their business projects. The research on individual factors of influence has mainly been concentrated to social skills and motivation as explanatory variables of success while other personal traits, such as cognitive abilities, have been somewhat neglected. We viewed this as a shortcoming and assumed the cognitive abilities to be of major importance to the entrepreneurial field of study. The purpose of this thesis has hence been to examine whether there are any cognitive abilities that are characteristic for entrepreneurs and that differ from those of non-entrepreneurs, with the aim to contribute to the explanation of what determines entrepreneurial success. By utilizing a new test battery, including test variables little studied, we have had the possibility to examine not merely cognitive differences, but also differences in executive ability and self-efficacy (important determinants of behavior according to cognitive psychologists). The necessary data was obtained by testing entrepreneurs with a computerized aptitude test (APT). Furthermore, a North American study has concluded that entrepreneurs to a larger extent than non-entrepreneurs suffer from ADHD, or hyperactivity. Since an ADHD-diagnose often affect individuals' cognitive abilities, an additional questionnaire assessing ADHD has been used. 32 entrepreneurs have participated and their results have been compared to three control groups, one representing the population norm, one group of executives and one group of academics.

Cognitive abilities that have been tested and discussed within this study include problem solving abilities, flexibility, choices of strategy, impulsiveness, memory and learning, planning capacities, self-efficacy and risk-taking propensity. We have also assessed the effectiveness of the entrepreneurs' performance, i.e. their ability to monitor, self-correct and regulate the intensity, tempo and other qualitative aspects of delivery.

Analysis of the APT-results indicated that there are significant differences between the cognitive profiles of entrepreneurs and non-entrepreneurs. The most apparent difference was the entrepreneurs' extraordinary performances regarding focused attention, something that has led us to the conclusion that the entrepreneurs' ability to focus solely on one task can be a reason for their success. Since so extremely focused, they have the ability to maintain a high concentration even if tired or in an environment where there are many potential distractions. The ADHD-questionnaires also displayed a highly significant overrepresentation of ADHD-individuals among the entrepreneurs, indicating that entrepreneurs can be characterized as stimuli-driven (distinctive attributes for ADHD-individuals). Environmental stimuli are probably what the entrepreneur reacts to and what motivates her/him to work hard. The reward must not be economic well-fare, but might as well be a sense of personal satisfaction from having engaged in tasks perceived as interesting and stimulating. As many entrepreneurs state: "It is the road that make the goal worthwhile".

The entrepreneurs' executive functions showed to be weaker than we had initially expected, mostly due to low flexibility and planning deficits. Uncalculated risk taking also proved to be a pervading characteristic of the entrepreneurs, combined with relatively low self-efficacy. These findings support existing theories, asserting that entrepreneurial success actually stems from the entrepreneur's ability to attract skillful people to her/his closest network, thus securing objective reviewing and execution of their own creative ideas.

Our findings imply that being aware of the cognitive advantages and weaknesses that entrepreneurial persons possess, will be of use to organizations, venture capitalists or others who wish to either identify or encourage entrepreneurial abilities amongst employees or other individuals related to the business.

1.1 ACKNOWLEDGEMENTS

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2 INTRODUCTION

"The problem of explaining why some succeed while others fail is crucial to the study of economic development"

Casson 1982, p. 10

Business environments are becoming ever more dynamic and demanding. Competition gets tougher and survival within business communities is to a great extent secured by never-ending adaptations to rapidly changing circumstances. This has created a growing demand for individuals possessing entrepreneurial skills - individuals who know how to capitalize on business opportunities and turn them into prospering companies or projects.

Efforts to answer the question of what determines entrepreneurial success have been made during more than thirty years but have led to no consensus. Today, the actuality of this question is higher than ever before. All research that might lead to a better understanding of what abilities that characterize a skilled entrepreneur are hence of interest.

According to entrepreneurial theory, which originates in the 18th century, entrepreneurs are differing in their behavior compared to others. But until recently, researchers have mainly focused on social psychology or environmental factors when trying to explain why someone succeeds as an entrepreneur and what characterizes that person. The cognitive psychology was long neglected despite the fact that cognition, executive ability and personality are the main psychological factors that effect behavior (see section 3.2). Fortunately, this perspective has lately started to gain recognition and suggests that valuable insights into the questions of what determines entrepreneurial success may be obtained through careful comparison of the cognitive abilities of entrepreneurs and non-entrepreneurs (Baron, 1998; Delmar, 1996). Cognitive abilities are innate and refer to capabilities such as perception, attention, memory and learning, problem solving, thinking, self-efficacy and ability to express oneself. The sparse research has generally yielded disappointing results, partly due to small or poorly chosen samples but also to vague definitions of entrepreneurial performance. Furthermore, test batteries of high statistical power and objectivity are hard to find.

Another drawback of the few studies focusing on cognition as an explanatory variable of entrepreneurial success is that academic rather than practical, or tacit, intelligence is being measured. Still, an extensive body of research indicates that real-life performance relies more on practical intelligence than on academic skills (Delmar, 1996).

2.1 PURPOSE

The purpose of this study is to examine whether there are any cognitive and executive abilities that are characteristic for entrepreneurs and that differ from those of non-entrepreneurs. The study is explorative, thus trying to find variables that can explain or predict who has the possibility to become a successful entrepreneur. By utilizing a new test battery, including test variables, which have not been extensively investigated, this study aims at discerning not merely cognitive differences, but also differences in executive ability and self-efficacy between entrepreneurs and non-entrepreneurs.

We propose that if discovering or creating opportunities and deciding to capitalize on a business opportunity is, at least to some extent, a function of cognitive abilities, then perhaps these abilities can help us discern entrepreneurs from non-entrepreneurs and predict who will presumably succeed as an entrepreneur.

It should be emphasized that the most reasonable model of entrepreneurial success is the one where many interacting factors are involved in the creation of an entrepreneur. The reader should be aware of the fact that cognitive abilities alone cannot explain entrepreneurial success. Additional factors such as social background, environmental factors, luck, serendipity, motivation and even gender are also important modulating variables. The aim of this thesis is to study the cognitive variables and executive abilities in detail, while other factors will be only briefly described and discussed as an introduction to the theoretical section.

When searching for information concerning entrepreneurial cognition we came across a North American study, which concluded that entrepreneurs to a larger extent than non-entrepreneurs suffers from ADHD (Attention Deficit Hyperactivity Disorder), in Europe denoted Hyperactivity disorder. Since we found these findings to be of high relevance to this study a self-report screening instrument for ADHD, developed at the Department of Psychiatry, Lund University was administered.

2.2 QUESTION AT ISSUE

After this brief introduction we are ready to formulate hypotheses based on the following questions:

Do entrepreneurs possess cognitive- and executive abilities that differ from those of non-entrepreneurs?

If yes, which are those specific abilities and to what extent can they explain why a person succeeds as an entrepreneur?

Can entrepreneurs to a larger extent than the normal population be diagnosed with ADHD?

The following hypothesis will be tested:

H₁: There are differences in cognitive- and executive abilities between successful entrepreneurs and non-entrepreneurs.

H₂: Entrepreneurs with ADHD out of the sample group > 4%, the average for an unselected population.

2.3 STRUCTURE OF THE THESIS

The thesis takes its starting point by presenting the definitions chosen for limiting the study to a specific sample group of entrepreneurs followed by a general, brief overview of entrepreneurial theories and research findings. The remaining part of the theory section will be devoted to psychological theories that are of interest when analyzing the results obtained in the test. The theoretical background then passes into the empirical chapter in which both the research design and the main findings will be presented. Lastly, a more elaborate analysis with the aim of summing up the conclusions made from the study and suggesting for its theoretical and practical implications concludes the thesis.

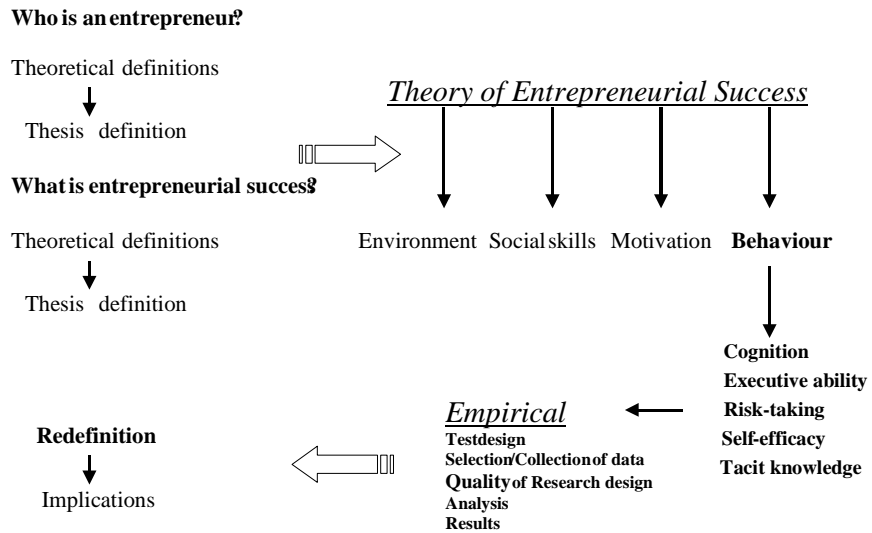


Fig 1

2.4 METHODOLOGY

The main informational and theoretical sources used in this study have been found in the literature on entrepreneurial research, cognitive psychology and psychological assessment. In order to get a more profound knowledge of prior research results and the latest update on recently discussed issues concerning the topic at hand, several interviews and discussions have taken place with researchers from universities in Sweden as well as with employees within organizations connected to the subject.

The thesis is based on quantitative data obtained by testing entrepreneurs with a computerized aptitude test (APT) developed by Levander and Elithorn (1960 - ff). In order to analyze the data, SPSS (Statistical Package of Social Sciences) has been used as the major analytical tool.

The main supportive theory of the analysis has been that of cognitive psychology, with a focus on cognitive and executive abilities as well as self-efficacy. Furthermore, prior entrepreneurial research have been used in the analysis in order to connect the results found in the present study with entrepreneurial theory, thus implying whether to support or reject hypothesis postulated within other studies.

2.4.1 Definition of an Entrepreneur

For more than one hundred years researchers interested in innovation processes and new venture creation have attempted to find and construct definitions of what constitutes an entrepreneur. The term was first recognized by French economist Richard Cantillon (1725) who linked the risk bearing activities in an economy with that of the entrepreneur. Ever since, the discipline of entrepreneurship has followed several different patterns of evolution, resulting in an extensive body of research that reveals some similarities as well as great many differences in the characteristics of an entrepreneur.

For some researchers, the entrepreneur is someone who is alert to profitable opportunities for exchange, possess additional knowledge and information and acts as an intermediary between suppliers and customers. Others, by contrast, view the entrepreneur as an innovator that causes change in the economic systems. Still others come closer to the commonly held view of the entrepreneur as a risk-taker, as someone willing to take calculated risks as long as the expected outcome is profitable. An entrepreneur has also been defined as someone who imagines opportunities instead of perceiving them. Casson (1961) claims that entrepreneurs have specific abilities compared to others, abilities that make them think and act in an entrepreneurial way (Deakins, 1996). Modern use of the term 'entrepreneur' is, however, usually credited to Schumpeter (1934) who emphasized the role of innovation in transformation of economic systems and viewed the entrepreneur as an innovator (Keller & Scott, 1991).

Isachsen (1996) suggests that entrepreneurs can be subdivided into different categories or entrepreneurial styles. He describes four different types of entrepreneurs; (a) *the administrator* - someone who continues to build an existing enterprise within a known industry or practice; (b) *the tactician* - someone who delivers spectacular performance within a known technology; (c) *the strategist* - someone who realizes and seizes opportunities in terms of to-be-completed concepts; (d) *the idealist* - someone who turns a dream or an idea into an enterprise.

Nevertheless, it is generally recognized that entrepreneurs serve as agents of change and provide creative, innovative ideas for business enterprises and help businesses grow and become profitable (Kuratko & Hodgetts, 1998). In this thesis, an entrepreneur is defined as someone closely linked to new venture creation and/or someone who has been involved in the realization of innovative projects that have resulted in prospering companies or in substantial development of a specific area (Isachsen's strategist or idealist). This definition is consistent with the one given by Kuratko and Hodgetts (1998), who defines an entrepreneur as:

"An innovator or developer who recognizes and seizes opportunities; converts these opportunities into workable/marketable ideas; adds value through time, effort, money or skills; assumes the risks of the competitive marketplace to implement these ideas and realizes the rewards from these efforts."

Kuratko & Hodgetts, 1998, p. 672

2.4.2 Definition of Entrepreneurial Success

While success has often been equated with rapid growth or high turnover rates some scholars have lately shown that entrepreneurs can achieve success in more qualitative terms (Brytting, 1998). Success should only be defined in terms of some predefined

objectives or goals since some entrepreneurs may voluntarily choose not to expand their business. Of great importance is, however, to effectively communicate the internal goals to the market so that the external expectations¹ will not get too high and lead to disappointment. Thus the following definition can be used:

”Success in entrepreneurial terms is achieved when the objectives and goals of both the entrepreneur and of the external environment are either met or exceeded.”

Ankarona & Robinson, 2000. p. 19

2.4.3 General Definitions

The following terminology will occur throughout the thesis:

- APT (Automated Psychological Test), the test used in the empirical study.²
- CNS (Central Nervous System)
- Msec (millisecond).
- SD (standard deviation).

¹ i.e. stock market and press.

² Developed by Sten Levander and Alick Elithorn 1960 - present.

3 THEORIES OF ENTREPRENEURSHIP

The theoretical session takes its starting-point in an overview of the dominating theories of entrepreneurial performance. Thereafter, we engage in explaining the theories of greater importance to this study, i.e. theories of cognitive psychology.

3.1 THEORIES OF ENTREPRENEURIAL SUCCESS

There are different conceptual ideas on entrepreneurship. As for this section, we will concentrate on theories dealing with entrepreneurial success, since other theories are of minor interest for the scope of this thesis.

Broadly speaking, the theories on different patterns of thought on entrepreneurial success can be divided into two categories – theories concerning *individual* factors of influence and theories concerning *environmental* factors of influence, hereafter called the environmental school of thought and the individual school of thought.

3.1.1 *The Environmental School of Thought*

This school of thought is characterized by a focus on environmental factors in trying to explain the entrepreneurial performance. These factors can constitute either a positive or a negative force for the entrepreneur. An external locus of control dominates, meaning that external factors that lie beyond the control of the entrepreneur strongly influence her or his choice to become an entrepreneur as well as her or his behavior and the success of the firm or the project. *Social influences* from family, relatives, friends and colleagues together with *work environment* and *characteristics of the market* (competition, customers, regulations etc.) are the factors most widely mentioned. Furthermore, some researchers have emphasized the role of an individual's childhood and political environment as well as financial capability in the formation-process of a successful entrepreneur (Deakins, 1996). *Task difficulty* and *luck* are other elements of major importance for the environmental school of thought (Gartner, Gatewood & Shaver, 1995).

Recently, many researchers have argued that entrepreneurship is born out of entrepreneurship and can thus be said to possess a *self-reinforcing* property. If this were the case, it would explain why certain areas inhibit a large amount of entrepreneurial activities where as in other areas such activities hardly exist at all (Bygrave & Minniti, 2000). Still, it does not offer any explanations to the question why some people become successful entrepreneurs and others do not, even if they grow up and live in the same region.

Another important approach to the environmental school of entrepreneurship, only recently recognized by scholars, is the notion that entrepreneurial performance heavily depends on the entrepreneur's *network*. Without good personal contacts the entrepreneur will have limited chances to succeed, no matter how skilled or intelligent she or he might be. It has often been argued that an immigrant's greatest impediment to become a successful entrepreneur is the lack of strong network-relations (Young, 1998).

Furthermore, some researchers claim that one single entrepreneur can never be ascribed to have created business success on her or his own. Instead, a prospering company is often the outcome of an efficient *teamwork* generated by people who each possess distinctive skills that complement each other. Taken together, these studies have led to a belief that team-founded ventures have a greater likelihood of success than ventures founded by solo entrepreneurs (Chandler & Hanks, 1998; Timmons, 1999).

Some scholars even argue that individuals exposed to much unfairness and bad treatment during child- or adulthood are the ones that become successful entrepreneurs since they are driven by a wish to revenge and to show that they are high achievers (Deakins, 1996; de Pillis, 1998). Others claim, by contrast, that successful entrepreneurs have a stronger relationship to their families than unsuccessful entrepreneurs have (Plaschka, 1990).

3.1.2 *The Individual School of Thought*

This psychological perspective of entrepreneurship has mainly focused on finding specific personality attributes or traits that are shared among successful entrepreneurs. The problem with this perspective is the inconsistency of the literature. A multitude of traits has been suggested to be relevant. However, researchers have not reached consensus on the traits' relevance, nor been able to specify interaction patterns between environmental and situational factors. Among the most popular characteristics to be found in the literature are; an achievement- goal orientation and need for independence, responsibility and power (Lohmann, 1998). The field of psychological traits can, somewhat simplified be subdivided into three main areas - social skills, cognitive abilities and motivation. The concept of cognitive abilities is our focal point and will therefore be more thoroughly discussed in the next session, while this section will briefly describe the theories concerning social skills, motivation and need for achievement.

3.1.2.1 *Social Skills*

An extensive body of research suggests that *social skills* - competencies that enable individuals to interact effectively with others - can positively affect their outcomes in many business contexts. Research conducted by Baron (1998) implies that such skills also play a role in entrepreneurs' success. The Baron study, as well as several other studies, indicates that many of the tasks entrepreneurs must accomplish in order to succeed involve the social side of life. These tasks include activities such as: raising capital, generating enthusiasm and commitment in others, communicating effectively with people from a wide range of backgrounds, selecting the right partners and employees, developing networks and relationships, establishing trust and legitimacy etc. (Baron & Markman, 1998). The following social skills appear to be of highest importance: (a) *social perception* – accuracy in perceiving others with respect to their traits, motives and intentions; (b) *impression management* –ability to induce positive reactions in others; (c) *persuasion* and *influence* – techniques to change others' attitudes and behaviors in the desired direction; (d) *emotional intelligence* – ability to control one's own emotional reactions and to influence others' emotions; (e) *long-term relationships* – skills in establishing effective long-term relationships. In addition, one aspect of entrepreneurs' social skills, namely their *social adaptability*, has been proven to be a significant predictor of their success (Baron & Brush, 1998).

Baron and Markman (2000) distinguish between social capital and social skills. Social capital are the actual and potential resources individuals obtain from their relationships with others in terms of a favorable reputation, high status and personal referrals. This often helps the entrepreneur to “get through the door” – to gain access to venture capitalists, potential customers, partners and others. Once inside, their ability to interact effectively with others – their social skills – plays a key role in subsequent success.

3.1.2.2 Motivation

Delmar (1996) and Isachsen (1996) have elaborated on the concept of motivation as a stimulus for entrepreneurial success. One important component of motivation is interest, since it has a positive effect on success. It is assumed that successful entrepreneurs act on intrinsic motivation, i.e. work hard and succeed because they find the task interesting and enjoyable. Entrepreneurs acting on extrinsic motivation, i.e. to get a reward and not because the task in itself is attractive, tend to perform more poorly (except from individuals who are highly achievement oriented, see below).

3.1.2.3 Need for achievement

Another important part of the motivational concept is “need for achievement”. McClelland (1961) asserted that need for achievement is *the* psychological driving force for economic growth. This can be seen as the assertion that initiated the search for the “personality characteristics of the successful entrepreneur”. Achievement motivation was first defined in Murray’s (1938) system of personality and is still one of the personologist’s best candidates in the attempt to account for new venture creation. Subsequent researchers (Stewart et al, 1999; Plaschka, 1990) have found that entrepreneurs are more achievement-oriented than the general population. After reviewing the vast body of research on achievement motivation and need for achievement, Shaver and Scott (1991) support the conclusion that achievement motivation is a valid predictor for entrepreneurial success. However, this argument has been criticized because other studies have shown no, or only weak correlation between achievement motivation and entrepreneurial activity (de Pillis, 1998).

3.1.3 Discussion

Most likely, the entrepreneurial success is determined by a combination of all the above mentioned factors, meaning that we need to take both environment and psychological factors into account when searching for causal mechanisms determining business success (Drucker, 1993). As outlined by Lewin (1951), the Establishing of a Business (EB) can be seen as a Function of the business founder's Person (PF) and his Microsocial Environment (ME).³

$$EB = f(PF, ME)$$

As earlier mentioned, it seems as of research on cognitive abilities has so far been given less attention than other approaches when describing entrepreneurial performance. We will therefore study a limited part of the PF-factor, namely the cognitive abilities of the entrepreneur. Thereby, this thesis will mainly engage in and use cognitive psychological theories as basis for the following analysis. Some theories can be classified as purely social cognition while others even fall outside the realm of cognitive psychology. Some will be more briefly discussed than others.

³ see Plaschka, G (1990).

3.2 BEHAVIOR AND ENTREPRENEURSHIP

Even though environmental and social factors might have a significant impact on entrepreneurial performance, there are still questions to be answered; why do some entrepreneurs succeed in a particular environment where others would fail? Why do someone recognize an opportunity where others do not?

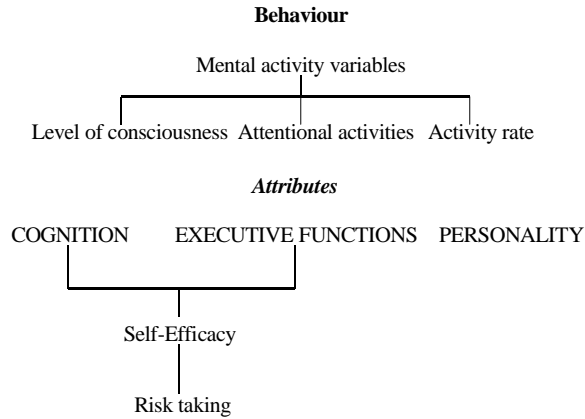


Fig 2

Part of the answer to these questions might be found by looking at the cognitive differences in terms of executive- and information-processing ability between entrepreneurs and non-entrepreneurs, but also by studying the entrepreneurs' beliefs of their own capacity (i.e. their self-efficacy). The level of self-efficacy is important to take into account since it is not sufficient to possess specific abilities. The entrepreneurs also have to be aware of their own abilities and limitations given a specific situation. In neuro-psychology, *behavior*, which has been the aspect of entrepreneurship most studied, is to a large extent influenced by cognition and executive ability apart from what can be characterized as personality (Fig.2). When choosing to further investigate entrepreneurial behavior through cognitive and executive abilities of entrepreneurs it becomes logical to focus on theories of cognitive psychology. Figure 2 will be used as a point of reference in the coming sections. We will conclude the theoretical session by discussing theories of practical intelligence/tacit knowledge.

3.2.1 Cognition and Entrepreneurship

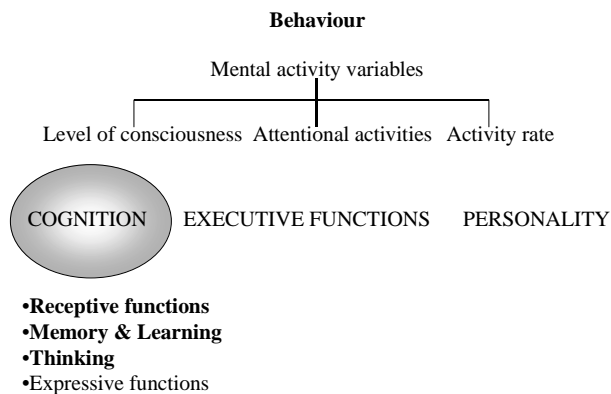


Fig 3

Cognition as a word probably goes back to an ancient language that later developed into Greek as well as Latin – the Greek word *gnoscere* means to know, and the corresponding Latin word has a similar meaning.

In psychological theory cognitive activity was long considered as the activity underlying intelligence. There is a disagreement among leading scientists as to the definition of intelligence, but, as underlined by Neisser et al (1998), these differences are not great. In this context we will define intelligence as *the capacity for flexible problem solving*

Lezak (1995) has defined four cognitive classes which are considered to affect and influence an individual's behavior (Fig. 3). *Receptive functions* involve the abilities to select, acquire, classify and integrate information. *Memory and learning* refer to information storage and retrieval. *Thinking* concerns the generation of patterns and the organization of information. Lastly, *expressive functions* is the output, an act through which information is communicated and is given purpose and meaning in terms of writing, speaking and making gestures. Normally, all functions are integrated into a complex pattern that is partly shared and partly unique for each individual.

Receptive functions include entering information, coded in a meaningful way, into the central processing system - a process that starts with some kind of sensory stimulation via our five senses. It also includes *information processing* which has shown to be vital in decision-making tactics - tactics that differ between individuals and between situations (decision-making involves thinking processes and choices based on gathered information). This perspective states that people think differently and that such variation may help differentiate people who will start companies from those who will not. Baron & Markman (1999) actually suggest that entrepreneurial success is closely related to the way entrepreneurs perceive information and process knowledge.

Currently, hierarchical models of the cognitive problem solving system have become popular. At the top there is a g-factor (general intelligence), supported on the next lower level of broad aptitude factors like verbal, visuo-spatial and reasoning skill. On the next lower level there are several specialized modules subserving rather narrow tasks. There are enormous differences in these narrow aptitudes among people – for instance mathematical skills (human calculators with Asperger syndroms like the movie character Rain man), and musical skills (perfect pitch and tape-recorder like music memory, for instance Mozart). The “unique skills” approach has to our knowledge never been considered in studies of entrepreneurial success. Such an approach has by definition to be anecdotal rather than based on group statistics, but will not be elaborated upon further in the present context.

Driver & Mock (1975)⁴ have identified two dimensions of information processing in decision-making, the focus dimension and the amount of information utilized. By combining the two dimensions of information processing in decision-making, four basic decision styles can be derived (fig.4).

⁴ Reference in George Wright (1985).

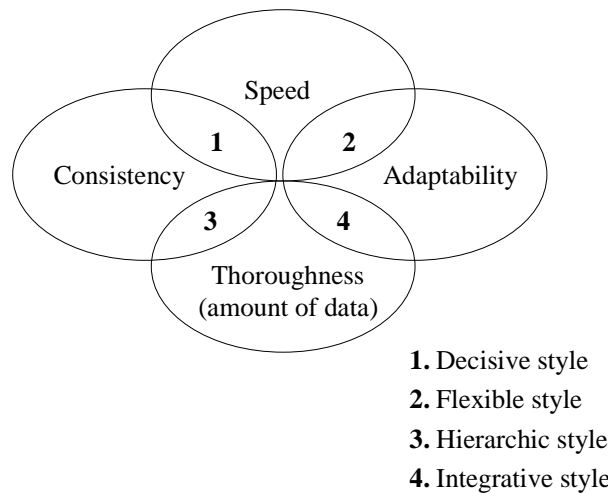


Fig 4.

The *decisive* style is characterized by the usage of a minimal amount of information to generate one firm option; thus speed, consistency and efficiency are aspects of concern. The *flexible* style also uses minimal data but regards the data set to have different meanings at different times, thus it is associated with speed, adaptability and intuition. In contrast the *hierarchic* style uses masses of carefully analyzed information to arrive at one best conclusion. Precision, perfectionism and thoroughness are characteristics of this approach. Similarly, the *integrative* style uses masses of data, but will generate a multitude of possible solutions. It is a highly experimental, information-loving creative style. According to current research it seems as if entrepreneurs do not have any 'road maps' to their decision-making (McGarth, Chen & McMillan, 1998), implying that style number 2 or 4 might be considered applicable on entrepreneurs. Thus, this theoretical model might give important insight into decision-making amongst entrepreneurs and work as heuristics when evaluating differences between entrepreneurs and non-entrepreneurs. It should be noted that the executive system has, so far, not been considered as a possible angle of approach in scientific analyses of entrepreneurial characteristics.

Central to all cognitive abilities is the capacity for **memory and learning**. There are at least three long-term storage memory systems of interest in cognitive theory: declarative memory, episodic memory and procedural memory. *Declarative memory* refers to the ability to learn about and memorize facts (e.g. what we learn in school). This type of memory always involves awareness in order for the individual to retain or revive impressions and recall or recognize previous experience (Lezak, 1995). The *episodic* or *personal* memory system reflects personal experiences, it has often visual (in contrast to language based, sequential) qualities, and the retrieval process can mobilize information that appeared not to be stored when awareness was first focused on the actual memory trace. The *procedural* memory is a habitual memory system, i.e. it works automatically without the need of awareness (remember how to walk, talk, eat etc).

The short-term memory systems (working memory) are organized in a similar way, i.e. there is one sequential language-oriented system and one visually oriented global type of short-term memory, like a sketchpad. Working memory requires continuous attention, otherwise the memory traces disappear within a few minutes. The amount of information of the two kinds that can be kept active and manipulated over longer periods of time varies markedly among individuals. For instance, programmers have to keep huge amounts of information continuously active in their working memory, which

requires focused attention and vigilance in addition to the ability to manipulate information. Good programmers (and hackers) appear to forget time and neglect bodily needs when working on complex projects. Writers and composers present similar anecdotal reports. Being able to focus on a specific task while neglecting other competing stimuli can be estimated by the APT system, giving us an indication of the entrepreneurs' ability to focus solely on one task.

Thinking is an umbrella term, which includes a large number of cognitive abilities such as computation, reasoning, judgment, concept formation, organizing and problem solving. The nature of the information and the operations needed to transform a large amount of information from a variety of sources into something of substance define the category of thinking. Furthermore, the complexities of these operations create a hierarchy of higher and lower mental processes. Abstract thinking is of higher complexity in comparison to concrete thinking processes. Traditionally, the higher cognitive abilities have been equated with intelligence. Problem solving, for example, encompasses a vast range of normal cognitive abilities. Complex problem solving comes into play when we initiate non-habitual or novel patterns of behavior, which require the reorganization of sets of established cognitive abilities or when we have to change our habits. The complexity varies broadly and involves executive functions as well as thinking since a problem first has to be articulated. The ability to shift comparatively rapidly between different concepts and to adopt different perspectives on a concept is a prerequisite for carrying out the operations necessary for most problem solving (McCarthy & Worrington, 1990). That is, one must be able to change and to modify one's responses in a flexible way.

Kirzner (1997) argues that opportunities are out there, waiting for entrepreneurs to discover them, while others speculate that entrepreneurs create opportunities rather than discover them (Baron & Markman, 1999). This implies that company creation is based on opportunities generated by complex thinking, an ability that is a cognitive function. If business opportunities were just lying around, noticeable to all, a lot more people would become entrepreneurs. Why? Because receptive functions, i.e. reacting to stimuli and processing information are quite basal abilities of all individuals. Thinking, on the other hand, (i.e. *the activity of the frontal lobe controlled central executive* in modern neuro-psychological theory) is unique and varies among individuals. If we want to find salient differences among human beings we should also look at the functions of the frontal lobes, i.e., at *executive functions*. The APT battery was specifically designed to assess such functions, and is unique among psychological tests in the way this is done.

Expressive functions, such as speaking, writing etc. is the sum of observable behavior inferred from mental activity. These functions are not testable within the chosen test battery. Therefore, they will not be further discussed.

3.2.2 *Executive Functions and Entrepreneurship*

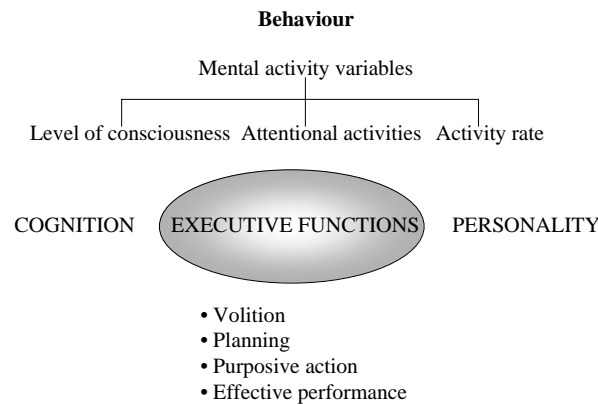


Fig 5

Regardless of whether a person discerns an opportunity or not, it takes executive functions and great perseverance to transform the vision into reality. In psychological theory executive ability is considered to include; volition, planning, purposive action and effective performance (including behavior such as error checking, goal achievement, and general self-monitoring).

Volition refers to the complex process of determining what one needs or wants and conceptualizing some kind of future realization of that need or want. In short, it is the capacity for intentional behavior. It requires the capability to formulate a goal or, at a less conceptualized level, to form an intention. Intentions can be well formulated by most individuals as dreams or visions, but very few manage to transform these visions into reality. Entrepreneurs do, and the reason might be explained partly by motivation, including the ability to initiate activity, which is a necessary precondition for volitional behavior.

Planning refers to the identification and organization of the steps and elements needed to carry out an intention or achieve a goal and involve a number of capacities. In order to plan, one must be able to conceptualize changes from present circumstances and deal objectively with oneself in relation to the environment. The planner must be able to conceive alternatives, weigh them, make choices and entertain ideas necessary for the development of a conceptual framework or structure that will give direction to the carrying out of a plan. The results of planning also demand memory skills and the capacity for sustained attention. Only little has been written about the ability of entrepreneurs to plan. However, the flexibility and ability of entrepreneurs to process large amounts of information found in earlier research may indicate that the planning procedure and the ability to conceptualize changes in the environment is a significant ability of an entrepreneur. The APT test will give us an indication of the entrepreneurs' planning capacities.

Purposive action describes the translation of an intention or plan into a productive, self-serving activity, which requires the actor (in this case the entrepreneur) to initiate, maintain, switch and stop sequences of complex behavior in an orderly and integrated

fashion. Disturbances in this programming activity seldom arise when routine or simple tasks are being executed (unless the person has a brain damage). But when it involves more complex activities, where there are no known ways of doing things, the lack of or the possession of an excellent programming ability becomes more obvious. Two of the most dominant factors of an entrepreneur according to research are *novelty seeking* and *purposefulness in action* (Wärneryd, 1988)⁵, which means that one basic characteristic of successful entrepreneurs is that they search more information than others do and that they do it with a specific purpose. In the APT test, the respondent has to make deliberate choices and hence give proof of purposive action.

A **performance** is as **effective** as the performer's ability to monitor, self-correct and regulate the intensity, tempo and other qualitative aspects of delivery. It involves choices of strategy (for example speed vs. correctness), choices that are essential to an entrepreneur in an ever-changing environment. In prior studies it has been stated that entrepreneurs are too forward-looking and optimistic (Palich & Bagby, 1995), neglecting mistakes made earlier while others show that entrepreneurs have an ability to respond positively to challenges and learn from mistakes (Timmons, 1994). They take personal initiatives and have a great perseverance and determination. The APT test will give insight to entrepreneurs' choices of strategy and their flexibility when facing change in the task that should be met with a different strategy.

3.2.3 *Mental Activity Variables and Entrepreneurship*

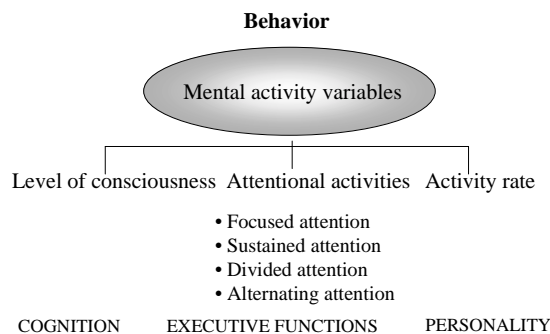


Fig 6

Mental activity variables are necessities for the behavioral functions (if not conscious one cannot memorize anything, regardless of how intelligent). The differences between individuals depend partly on the efficiency of the mental processes that are intimately involved in cognitive operations but do not, on their own, have a unique behavioral end product.

Consciousness may be defined as the general level of activity of the brain, e.g. being awake and receptive to stimulation. The level of consciousness ranges over a continuum from coma, via full alertness to disorganization and panic. The inverted relation between level of arousal and performance has repeatedly been demonstrated in general psychology, that is, for each task complexity there is a corresponding optimal level of arousal. If the task is simple (fight or flight) the optimal level is high. If a task is very complex (to play chess) the optimal level is a very narrow intermediate. Even a

⁵ Reference in Hamrefors (1999).

slight depression or fatigue may significantly affect performance adversely, in the same way, as a tiny disturbance raising the arousal level slightly will destroy most of the necessary concentration. It is possible that one aspect of entrepreneurial skill is the ability to modulate arousal effectively, i.e. be able to work for extended periods of time on a task-adjusted optimal level of arousal.

Attention is difficult to define but involves several processes that are related aspects of how an individual becomes receptive to stimuli and how she or he may begin processing incoming information. Most research indicates that attention is a system in which processing occurs sequentially within different brain systems (Lezak, 1995). It varies not only between individuals, but also within individuals under different conditions. Simple attention (how much information that can be grasped at once) is a relatively effortless process that does not vary greatly between individuals. Four other attentional mechanisms are of more interest in this study. *Selective attention (focused attention)* is well studied and involves being aware of dealing with information, while at the same time suppressing competing distractions (the ability to concentrate and focus). *Vigilance* (sustained attention) is the capacity to maintain attention over time, not being distracted or losing focus because of fatigue. Being able to respond to more than one task at the same time is called *divided attention* and is a necessary mental activity for simultaneous capacity. *Alternate attention* allows for shifts in focus and tasks and is a vital ingredient in flexibility and choice of strategy for an individual. An entrepreneur, since constantly subjected to large flows of information and in never-ending need for flexibility and change of strategy, might have more developed attentional abilities than non-entrepreneurs. Since the test session should not exceed one hour, respecting the entrepreneurs' busy agendas, only focused attention will be measured in the APT-test.

Activity rate refers to the speed at which mental activities are being performed. The most common way of measuring the mental activity rate is by testing the reaction time of an individual while performing a specific task. Entrepreneurs can be assumed to have a relatively high mental activity rate, something that will be tested by the APT battery.

3.2.4 *Self-Efficacy and Successful Entrepreneurship*

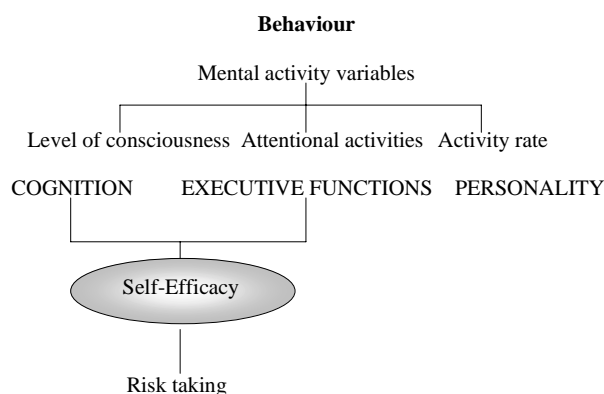


Fig 7

If translated into behavior, self-efficacy might be considered as effective performance, i.e. one type of executive function. This ability, to correctly rate your own performance, has been studied carefully by researchers on entrepreneurship.

Many studies propose that self-efficacy is a major cognitive variable in the functioning of any entrepreneur (Boyd, Chandler & Gartner, 1992; Krueger & Brazeal, 1994). The reason is that self-efficacy is a key variable in determining if and how much effort the entrepreneur will extend on the venture, and how long that effort will be sustained in terms of cognitive and behavioral persistence. The expectations of successfully coping with the environment, in spite of potential difficulties, and of being able to establish new ventures are referred to in social cognitive theory as *self-efficacy beliefs*. Such self-efficacy represents a personal judgment as to how strongly entrepreneurs believe that they can master the necessary cognitive, memory processing and behavioral facilities to deal effectively with the environment and the specific entrepreneurial venture. More or less, self-efficacy refers to a judgment of one's capability to accomplish a certain level of performance or desired outcomes (De Noble, Ehrlich & Jung, 1995).

Self-efficacy has a number of practical and theoretical implications for entrepreneurial success, because initiating a new venture requires unique skills and mind sets, which may be far different from those required for executives in a fully established organization. Sometimes, roles for an entrepreneur may not be clearly defined, and many uncertainties may exist regarding the success of one's venture. One of the strongest barriers that an entrepreneur has to overcome is the anxiety about her or his success throughout the initial start-up process. By definition, an entrepreneur with a high level of self-efficacy, who also truly believes in his or her capability to execute all of the requirements to perform a task successfully, is more likely to see the positive potential outcomes that might accrue from a new venture. As a result, the entrepreneur may sustain more effort through the entrepreneurial process to achieve these positive outcomes.

Stajkovic and Luthans (1998) conducted a meta-analysis based on 114 previous studies of self-efficacy and found a significant weighted average correlation between self-efficacy and work-related performance ($r = .38$, thus supporting the positive effect of self-efficacy on individuals' motivation and performance. However, it wasn't until the early 1990s that researchers of entrepreneurship became interested in self-efficacy as a bridging concept, explaining an entrepreneur's initial effort to set up and grow a new venture. However, other studies have yielded the opposite results. Gatewood (1995) rejects the hypothesis that high personal efficacy scores should be likely to persist in actions that lead to successfully starting a business. Krueger and Dickson (1994) assert that self-efficacy can affect the risk-propensity of an entrepreneur since people who believe in their risk taking competence tend to see more opportunities than risks in a risky venture. Baron and Markman (1999) found that not only did entrepreneurs show a higher degree of self-efficacy, but also that entrepreneurs are less likely to become victims of the so called planning fallacy (a tendency to assume that one can accomplish more in a given period of time than is actually justified), rely less on heuristic thinking (thinking-shortcuts, i.e. using know-how from prior experience in new situations), are more alert and less likely to be overconfident. Once again, other research studies have clouded the results of previous one's by delivering significant findings of differences between e.g. executives and entrepreneurs. Busenitz and Barney (1997) conclude in their study of strategic decision-making that entrepreneurs are more overconfident than executives, thus making more risky decisions as a result of low self-efficacy.

A reasonable explanation as to why so varying results have been obtained is probably because the tests used were not assessing actual performance, but are rather subjective estimations of what has been accomplished by the entrepreneur (the efficacy-rates given by the entrepreneur are measured against an invalid scale). Since the APT-battery

objectively measures actual performance, the self-ratings will give a good measuring tool for self-efficacy with high significance. This has, to our knowledge, not been done before, something that makes the theory of self-efficacy of interest for this study.

3.2.5 Risk Taking and Entrepreneurial Success

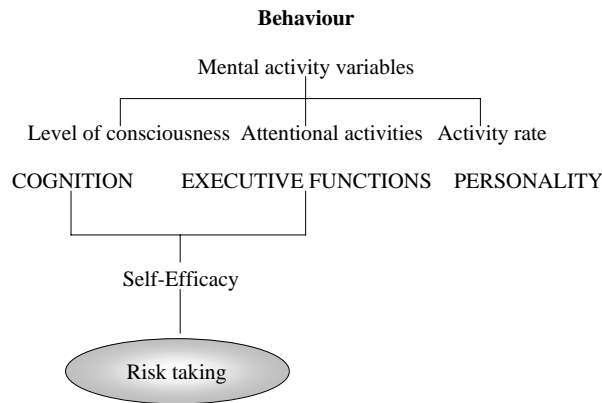


Fig 8

It has since long been acknowledged that risky decisions are not based solely on rationality. Confronted with uncertainty in general equilibrium conditions, it is an individual's predisposition toward risk that affects the decision to pursue an entrepreneurial career (Bird, 1989). A stem of research has emerged which examines the effects of psychological processes on decision-making. The risk propensity studies are predicated in support of risk taking being pre-dispositional rather than simply situational. Accordingly, risk taking should be treated as a cognitive characteristic.

There are two main research movements on entrepreneurial risk propensity. One states that entrepreneurs take more risks than do non-entrepreneurs (in this case middle-executives) because the entrepreneur faces a less structured, more uncertain set of possibilities and also bears the ultimate risk of the venture. Furthermore, since entrepreneurs prefer the risk of being self-employed, they do take a larger risk than do executives. The second theoretical approach to risk propensity takes a motivational starting point, claiming that persons with high need for achievement set challenging goals of intermediate difficulty and are moderate risk takers since they are reluctant to fail the pre-set goal (Bird, 1989). Since non-entrepreneurs also are considered being achievers, they should have the same risk propensity as entrepreneurs according to motivational theory.

Surprisingly, efforts to reveal differences between entrepreneurs and others with respect to risk-taking and other aspects of personality have met with only modest success (Bird, 1989). Still, considerations of risk and potential losses are crucial elements in the decision to start a new venture. Entrepreneurial theory has long viewed entrepreneurs as bold risk-takers, willing to put both their own fortune and other's at stake in their efforts to develop new ideas. Conversely, executives in many well-established firms are thought to be risk averse, preferring safer ventures with lower potential return. Both of these views have been challenged. Some argue that there are no differences in risk-propensity between entrepreneurs and non-entrepreneurs (Brockhaus, 1980), while others have found evidence that risk-prudence of entrepreneurs is a necessity for efficient risk-management and thus vital for the survival

of the venture (Timmons, 1994). Mullins & Forlani (1988) found no significant difference between entrepreneurs and non-entrepreneurs in terms of risk-propensity. Interestingly, they did nevertheless find indications of a significant difference in perceived opportunity of a venture between entrepreneurs and executives, with entrepreneurs being less positive in their evaluation of the potential expected return of a specific venture. This implies that entrepreneurs are less inclined to take uncalculated risks. However, Stewart and Roth (1999) argue in a recent study that the results obtained in earlier research are subjected to bias because there were differences in sample size, and a lack of statistical power and reliability of instrumentation. Instead of a narrative analysis, Stewart and Roth conducted a meta-analysis based on a sample comprising more than 1000 individuals, thus they were able to discern a significant difference; entrepreneurs had a higher risk propensity than had executives ($d = .68$). Thereby, the motivational theory of risk-propensity was rejected. The analysis also suggests important information, namely that the instrument used to measure risk makes a difference in the conclusions of a study. Hence, any firm conclusions regarding the relation between entrepreneurs and risk propensity are thus premature. The APT-battery does not contain a specific variable that measures risk-taking, but does give a fair estimate if an individual acts impulsively. Other variables within the test that can give an indication of risk-taking propensity are flexibility in choices of strategies and consistency in problem-solving strategies.

3.2.6 Practical Intelligence and Entrepreneurial Success

Psychometric intelligence (IQ) tests, often used as predictors at schools, are less predictive of success out of school, especially when it comes to entrepreneurial achievements (Plaschka, 1990). Even the most liberal estimates of the relation between intelligence test scores and real-world criteria such as job performance indicate that approximately three fourths (75%) of the variance in real-world performance is not accounted for by performance in intelligence tests (Sternberg et al, 1995). Researchers have begun to explore new constructs in search of measures to supplement existing cognitive ability tests as predictors of real-world performance. Among the most promising constructs is practical intelligence, or common sense. Performance measures of practical intelligence predict real-world criteria such as job performance but are relatively unrelated to performance on intelligence tests and other common selection measures. Consequently, their contribution to prediction of entrepreneurial performance is largely independent of existing measures, including measures of cognitive ability (Sternberg et al, 1995).

In traditional test-batteries academic knowledge is measured, e.g. how well a specific, delimited task is executed. These tests give little information about how well the test-participant would do under real term conditions. Conditions faced by entrepreneurs are often ambiguous and therefore require a different measurement approach. Practical intelligence, or tacit knowledge, refers to action-oriented knowledge. It is about being 'street smart' and being able to choose the right strategies given a specific situation. Practical intelligence is acquired without direct help, and allows individuals to achieve goals they personally value. Findings from tacit knowledge research indicate that measures of tacit knowledge have a low correlation with standard mental tests and add significantly to the explained variance (Sternberg et. al, 1995).

Attempts have been made to create a suitable method for estimating practical intelligence in order to explain the remaining variance in IQ-tests, not explained by pure academic skills. Most of the recently developed tests are questionnaires describing

real life situations. The test participant is asked to answer a number of interconnected statements to how she or he would act under the given circumstances. This way, researchers are hoping to discern who is “street-smart” and who is not. The APT battery, on the contrary, assesses executive functions in an efficient way and since executive ability is considered a good predictor of tacit knowledge, an indication of the entrepreneurs’ practical intelligence is obtainable. The APT test-design emphasizes the below stated features (i.e. no correct solutions or strategies to obtain the solution) associated with practical intelligence.

Free interpretation from Sternberg et al , 1995

Academic intelligence

- Characteristics of traditional intelligence tests

- **the task is formulated by others**
- **the task often has little or no intrinsic interest**
- all needed information is available from the beginning
- **the test is disembedded from an individual’s ordinary experience**
- the task is well defined
- the task has one (1) correct solution
- the task has one (1) method of obtaining the right solution

Focal point: Declarative knowledge, i.e knowing *that*

Practical Intelligence

- Characteristics of real- life tasks

- the task is unformulated or in need of reformulation
- the task is of personal interest
- lack of information for a necessary solution
- the task is related to everyday experience
- the task is poorly defined
- **the task is characterized by multiple “correct” solutions**
- **the task is characterized by multiple methods for picking a problem solution**

Focal point: procedural knowledge, i.e knowing *how*

APT-test characteristics (bolded in the lists)

- Includes some of the most important factors for the measuring of practical intelligence
-

To conclude, it should be noted that researchers have obtained results with a positive correlation between IQ and tacit knowledge (Sternberg et. al, 1995). Consequently, the use of both kinds of measures results in more effective prediction of performance than reliance on either kind alone. This is also done in the APT battery, by weighting three different IQ-measurements.

The above stated quotas of practical intelligence reflect the situations often facing entrepreneurs in their daily work. The high degree of ubiquity in venture creation demands flexible and creative approaches to problem solving. The entrepreneurial success depends on the entrepreneur’s ability to not only know that she or he wants to do something, but also knows how to do it without having access to heuristics (standardized solutions to a specific problem, i.e. a mental shortcut).

3.2.7 ADHD - Attention Deficit Hyperactivity Disorder

Attention Deficit Hyperactivity Disorder (ADHD) is a common childhood neurobehavioral disorder occurring in 3-7% of children and mainly in males (Vassileva et al, 2000). Recent studies indicate that ADHD continues into adulthood in 30-60% of cases. Many entrepreneurs are school dropouts, having failed to complete their studies at a higher level than high school (Levander, 1999). The syndrome of ADHD offers an

explanation to why these seemingly talented individuals are unable to pass higher studies. An individual diagnosed with ADHD has attentional deficits resulting in difficulties to concentrate for longer periods of time, unless they are genuinely interested in the task at hand. They also have a hard time accepting failures (Dock, 2000). Current research indicates that entrepreneurs often have syndromes of ADHD or lie close to displaying ADHD. A North American study indicated that 18 percent of all ADHD-children become entrepreneurs compared to only 5 percent of the population at large. Hence, ADHD is not only related to negative characteristics. Generally, it also results in high levels of creativity, turning the individual into an energetic person and idea-generator who gets thoroughly involved in tasks she or he finds interesting, exciting and challenging.

A study conducted by Vassileva et al (2000) points out that adults diagnosed with ADHD display executive function deficits. In the study, ADHD-individuals and demographically matched control-groups were administered six computerized measures of executive functions: (1) Motor Timing Reproduction; (2) Stroop Test; (3) Levine Test of Conceptual Reasoning; (4) Posner's Task of Covert Visual Spatial Attention; (5) Inhibitory Control Test; and (6) N-back Test of Working Memory. The results indicated executive function deficits in ADHD-individuals. Other studies have yielded the same results (Dock, 2000). Dyslexia is also often occurring among individuals with ADHD.

If the present study reveals an overrepresentation of ADHD-individuals among entrepreneurs, it might indicate deficits in executive functions for a majority of the sample.

4 METHOD

When conducting the empirical study, we met with twenty-nine successful entrepreneurs who all participated in the below-described test-session under similar conditions. The theoretical concept presented initially will hence be operationalized as the ability to solve a set of specific and systematically varied problems in the form of psychological tests (the APT battery). The test-time was about an hour for each individual. In addition, the participants were asked to compile a questionnaire stating their background and merits as well as a questionnaire indicating if a person can be diagnosed with ADHD. The questionnaire comprised 101 questions concerning the entrepreneur's personality (see appendix).⁶

4.1 TEST DESIGN

The specific model of cognition (and intelligence) used in this context has been developed by Levander (1999).⁷ The test sessions included are listed in the appendix. Conventional IQ tests do not assess speed of processing – which conceptually as well as empirically should be an important component of intelligence. The APT battery is built around the concept that intelligence is reflected in the speed with which a standardized problem can be solved, not in whether a problem can be solved “correctly” (i.e. as predetermined), regardless of processing time.

Some tasks are so simple that almost no intelligence is needed, for instance simple and two-choice reaction time. Individuals vary surprisingly much in terms of processing speed for simple tasks. Typically the inter-individual differences of simple reaction times with a mean of 200 Msec have a standard deviation of 30 Msec among young and healthy individuals. Age, certain psychotropic drugs and some diseases slow down the processing speed substantially. Simple reaction time correlates approximately .25 with a conventionally assessed IQ score. Thus, response speed can be viewed as one aspect of intelligence. Factor analyses of large APT test data suggest that response speed to simple tasks and motor speed form one *speed* IQ factor (related to the activity rate theory).

Most assessment tasks are more complex than the reaction time paradigms. Such tasks can be rank-ordered, conceptually, along a complexity dimension. More complex tasks will require longer processing times and involvement of specific processing (cognitive) modules. The attention factor becomes more important - to be able to assign priority to one task, fighting distraction, or divide attention among tasks. Processing times of more complex APT tasks form an *attention* factor, orthogonal to the speed factor and with a much higher correlation (typically .5) with conventional IQ scores. The skill of solving complex problems reflects **basic aptitudes** that are well known in intelligence theory. Three basic aptitude factors have been repeatedly demonstrated in IQ research: **Verbal, Reasoning** and **Visuo-spatial** factors. They correlate positively, i.e., if one is high the two others tend to be high. This correlation has been interpreted as evidence of a **general** IQ factor, the *g*.

⁶ Designed by Anna-Karin Backman and Sten Levander, Psychological Department at Lund's University.

⁷ Algorithm included in APT test battery

Complex tasks can be solved in many different ways. This creates a need to select the best way to solve a problem, to monitor that the solution process runs as planned, and that the output of the process match the desired solution of the problem. This supervisory function has been denoted **executive**, in analogy with a CEO of a company. One important aspect of the executive system is the **working memory**, allowing us to *"keep a certain number of balls in the air"*. According to the APT model, failure of the executive system can be suspected if a subject, over a range of different tests, chooses unsuitable problem solving strategies, is insensitive to changes in the conditions governing the tests, and fails to appreciate her/his own performance level and strategy choices.

4.2 PARTICIPANTS

It is of utmost importance to choose a sample group that is not subjected to bias. Considerable attention was devoted to the identification of entrepreneurial typologies with a clear view emerging that entrepreneurs do not display homogeneous characteristics. Nevertheless, Robbie & Wright (1996) found similarities in individuals engaged in buy-ins; thus it can be expected that homogeneity might exist also among serial entrepreneurs. Repeating an entrepreneurial experience with an entirely new company is generally regarded as the classic case of serial entrepreneurship (Wright, Robbie & Ennew, 1995). However, serial entrepreneurship may also entail re-establishing a relationship with a previously owned company (now work for, but used to have a stake in). Another medium for serial entrepreneurship is provided by the possibility to do a management buy-in, e.g. buying a large managerial stake in an already existing company or doing a buy-in repeatedly, thus becoming a buy-in/ buy-out in new start-ups. In any case, serial entrepreneurship can and does take a variety of forms and is likely to involve a variety of different individuals with differing cognitive- and executive abilities, thus the likelihood of finding homogeneity within the chosen group is small. Still it is the best delimitation possible for the measuring of entrepreneurs against non-entrepreneurs. Thus, notorious-/serial entrepreneurs have been chosen to secure that their entrepreneurial behavior is characteristic for their personality and not an occasional incident, with the hope of finding some similarities/homogeneity amongst them.

In this paper we have chosen to only study entrepreneurs as single persons (singulars), not in the constellation of teams, networks or organizations of people (plurals), although the entrepreneurs tested have likely been influenced by others. Due to practical shortcomings, we have not been able to test entrepreneurs with foreign origins. Since they generally do not master Swedish as well as natives, this would require that the test battery be translated into their mother tongues.

To get in touch with the first group of entrepreneurs participating in the study we received much appreciated help from our tutor Sven Hamrefors and from the Swedish bank Föreningsparbanken. The meeting with this first group of entrepreneurs in turn led to further contacts. In addition, we contacted entrepreneurs that we read about in daily newspapers or that are publicly recognized as successful serial entrepreneurs. A large majority of the entrepreneurs contacted accepted to participate in the study. Only eight entrepreneurs rejected our request, five due to lack of time and three because they did not consider themselves as being successful entrepreneurs. One person chose not to fulfill the test, since he found it to be too basic for his level of competence. (It should be noted, however, that this person only sat in front of the computer for about five to ten minutes. He thus never arrived to the more complex tasks).

An important shortcoming of the data collection is the fact that most entrepreneurs tested are active in the Stockholm-region. Only four out of twenty-nine participants operate outside Stockholm, namely in Gävle and Brussels. This might have had an impact on the test-results. Furthermore, we did not manage to get in contact with enough female serial entrepreneurs. Consequently, only 30 percent of the test sample consists of females. In addition, due to the test being designed in Swedish, solely one participant had foreign origins. We have also discussed the possibility that only a certain kind of entrepreneurs tend to accept to participate in studies of this sort, while others tend to discard such requests. If so, this would probably cause biased results. Since most entrepreneurs asked chose to participate in the study we do, nevertheless, consider this to be a minor problem.

Control groups were selected upon the criteria that they are as equal to the sample group as possible (intelligence, gender, academic skills) but have not done anything that can be characterized as entrepreneurship. The three control groups will consist of: technological- and law students from now on referred to as academics, executives and a normative scale based on a large sample of Swedes with varying characteristics. The choices of control groups are based on recommendations from researchers within the area as well as on reviews of previous tests. Technicians and lawyers have never before been tested against entrepreneurs and are hence of interest. Managers have been used as control groups in several prior studies and their work situation lie close to that of many entrepreneurs.

4.3 QUALITY OF RESEARCH DESIGN

The choice of the APT test battery as the methodological test rests on the fact that it is *culture fair* and therefore does not, to the same extent as conventional tests, measure academic achievements. Partly, the test measures executive abilities, thus the academic background of an individual is not of importance. Regardless of profession an intelligent person will possess a fairly large portion of problem solving approaches (e.g. novel thinking and flexibility) of interest when measuring the more practical intelligence of an individual. Novel thinking and flexibility in problem solving are two factors given little or no attention in conventional IQ tests.

Furthermore, the APT battery offers a test design where no "right" answers are given - but a large variety of possible solutions to a problem. Thus, each test participant will display a unique individual cognitive ability-profile.

4.3.1 Reliability

When employing tests and trying to draw conclusions from the results, reliability concerns the consistency of scores obtained by the same persons when reexamined with the same test on different occasions (Anastasi, 1988). By reexamination the test reveals the *error of measurement* of a single score. The broad sense of test reliability indicates the extent to which individual differences in test scores are attributable to true differences in the characteristics under consideration or to chance error, e.g. estimating the *error variance*. Generally the difficulty is to decide whether or not differences are of interest for supporting the chosen hypothesis or is to be considered a chance error. If the latter is the case, the test conductors should try to reduce the error variance by reducing differences in testing environment, instructions, time limits and other similar factors.

4.3.1.1 Reliability of the test battery

The IBM PC has become a de facto standard for computerized test batteries. Unfortunately, there are several technical difficulties associated with its use. If we want to measure response times accurately, with a technical measurement error less than one percent of the shortest response times that man can obtain (around 125 Msec), time recording should be to the millisecond. We then need a real time system that is stable and where time keeping has the highest priority of all tasks. This is not the case for PC:s. What's worse is that times more fine-grained than 54 Msec are not available with standard soft-ware commands – one must write assembly level code to extract such information. Windows has become the standard operative system for PC:s. It is not a real time system, and it is very unpredictable as a platform for programs. It is simply not possible to measure time reliably under Windows. The old DOS system is not a real time system either, but it is simple enough to be predictable. Therefore, the APT battery must be run on a DOS machine. The next problem is the keyboard. Some psychological test batteries use the standard keyboard or the game port or the mouse port to record responses. These devices are serial and interrupt-driven. That introduces errors in measurement up to and exceeding 12 Msec under ideal conditions. If the interrupt has a low priority, time records can be highly inaccurate. Finally, most test systems present stimuli on the standard video monitor. These units typically have a refresh rate of 70 Hz, i.e., 14 Msec between sweeps. In order to keep the less than one Msec measurement error, stimulus onset must be synchronized with the sweep. These measurement errors have been minimized to approximately 1 Msec in the APT-battery by using a designed keyboard, and running the test on a DOS-computer.

4.3.1.2 Reliability of the test method

Using a computerized test-battery for gathering information demands that some information is given to the test participants prior to the test. This is also the case in this study, thus the issue of **coaching- effects** (Anastasi, 1988) arises meaning that instructions given might affect the participants performance. In this study the test conductors (the authors of the study) gave literally no information to the participating entrepreneurs before the start of the test-session. The computer, throughout the test, instead gave instructions, thus all participants were subjected to exactly the same information. Understanding and utilizing the information given by the computer is actually a part of the cognitive testing. Therefore no bias as a result of differing information given to the test participants has been likely to occur.

Furthermore, there is a risk that the mental state of the test participant might affect the performance. In order to minimize the potential **distress** of the participant we left the room, only if questions arouse did contact with the test-conductors (the authors of the thesis) take place during the test-session. For the entrepreneurs who couldn't sacrifice too much time, the test was conducted at their offices. For others the test was conducted at the Stockholm School of Economics because of the inconvenience of carrying the test equipment around. The fact that some entrepreneurs did the test in a familiar **milieu** when others did not, might have affected their performance. Those who conducted the test at their work place seemed less relaxed and might have had difficulties to concentrate when being surrounded by objects reminding of work. Overall, it is likely that the entrepreneurs were highly motivated to perform well on the test.

For some intelligence tests, **training** can lead to better results (Anastasi, 1988). Since none of the entrepreneurs had earlier participated in the APT test, the risks for such an

effect have been eliminated. Participation in other, conventional, intelligence- or reaction time tests might, to some extent, affect the performance in the APT test. Moreover, there is a slight possibility that persons who are used to handling PC's or playing data-games hold certain advantages when performing the test. Research has, though, proven that the APT battery is quite resistant to training effects (Levander, 1999).

4.3.2 *Validity*

"The validity of a test concerns *what* the test measures and *how well* it does so" (Anastasi, 1988). It also indicates what conclusions can be drawn from the results. Validity must be established with reference to the particular use for which the test is being considered. In this case the objective of this thesis to support or reject the hypothesis: "There is a difference in cognitive/executive abilities between successful entrepreneurs and non-entrepreneurs", can be considered a testing purpose of descriptive sort, thus it is combinable with construct-related evidence of validity.

Construct-related validity of a test concerns the extent to which a test can be considered measuring a theoretical construct or trait. Any data supporting or rejecting the posed hypothesis represent appropriate evidence for validation. For construct-related validation the following aspects are of interest in establishing validity of the test and the discussion below concerns the chosen APT battery.

4.3.2.1 *Correlation with other tests*

Tests included in the APT battery correlates well with standardized tests validated on large materials, for instance, the WAIS tests. The APT vocabulary test correlates .75 with the WAIS vocabulary test. APT IQ (the mean of seven (7) different sub-tests) correlates .75 with the corresponding WAIS IQ-measure.⁸

4.3.2.2 *Construct validity*

Premorbid IQ was estimated as the average 9th grade school character. On an average 20 years later, IQ was assessed by the APT battery in a group of schizophrenic patients. In spite of a large variability in terms of cognitive reduction among the patients, still the correlation was high, .56. There are several other examples suggesting a high construct validity of the battery.

4.3.2.3 *Factor analysis*

The factor structure of the APT battery is consistent with current theories of intelligence. Noteworthy is that there is a reproducible set of higher order factors that cross test borders and form meta-variables. Thus, indices of impulsiveness obtained from different test co-segregate into one factor, whereas indices of speed/accuracy trade-off form another factor.

4.3.2.4 *Internal consistency*

The internal consistency assessed by Cronbach's alpha is generally very high, in most cases higher than .90. Thus, the tests of the APT battery are homogenous. The standard error within individuals is much lower than the standard deviation between individuals.

⁸ Traditional IQ-measure invented in the 1920's.

4.3.2.5 *Discriminant validity*

It has been demonstrated that groups of subjects with various disorders affecting cognition do have marked differences in APT performance, e.g., schizophrenia, prisoners, diabetes and stroke.

Finally, since the APT tests are designed in a way that makes it hard for the respondent to know what the different tests serve for, he or she will not be able to consciously choose answers that lead to a specific desired result. The ability to steer one's answers toward a desired outcome has been a major problem for many other tests conducted within the entrepreneurial discipline. As an example, questionnaires earlier used to measure entrepreneurs' social and cognitive abilities have used direct and straightforward questions. Since humans strive to be consistent in their acting (Cialdini, 1993), the respondents have probably paid attention to not giving any answers that contradict previous answers. Moreover, even though people know that their answers are treated confidentially, they tend to pick the answers that best correspond to the person they *wish* to be, not to the person they actually are (Engel et al, 1995). The same holds for qualitative interviews. We hope to have dismissed these effects by using the APT battery, as it only measures real performance and thus is impossible to manipulate.

5 RESULTS

This section summarizes the main findings in terms of statistical data analyzed by the SPSS. Variables that were skewed (for instance reaction time data) were log or exp transformed so that an approximate normal distribution was obtained. All statistical calculations were based on parametric methods.

5.1 APT RESULTS

K-test (focused/selective attention)

The entrepreneurs participating in the test showed a mean performance of focused/selective attention of **T = 62** in comparison with the population mean of **T = 50**, i.e. approximately **1,2 SD** above the norm ($z = 6$, $\alpha = .001$). The high performance is primarily derivable from a preference for accuracy rather than speed. This preference increases as the tasks become more difficult. There were no signs of a preferred strategy in solving the problems, but an even distribution between global- and sequential strategies. The participants were normal in terms of flexibility between different strategies when faced with change in the test conditions. Some of the entrepreneurs displayed a performance level well over 3 SD above norms – i.e. a level which is encountered among normal subjects often less than 1 in 1000. The finding that so many performed on this level is the most significant finding, all categories, of the present study.

Short-term- / Working memory

Many of the entrepreneurs complained about having difficulties with the memory test. The mean, **T = 53**, of the sample group was barely above the norm (**T = 50**) thus, the entrepreneurs' memory was within the normal range for the population.

The Austin Maze

In the Austin maze test a mean value of **56** was obtained for the sample group compared to the norm of **T = 50**, which is **0,5 SD** above the norm (std. Error = 1.9, $z = 3$, $\alpha = .01$), thus significantly better than normal executive performance. On the contrary, consistency was much lower than the norm (**T=41**), indicating that entrepreneurs have a tendency of making many mistakes and not learning from them. The test participants' results on the Austin Maze test showed a trade-off between accuracy and speed (**T = 57**). The entrepreneurs were, as also noted in the K-test, faster than average, but in the Austin Maze test, where the task complexity is much higher, the higher speed performance was reached at the expense of accuracy.

Word test

Some of the entrepreneurs had dyslexia (6 subjects), still the sample group had been fast at decoding words (**T = 56**), and possessed a larger vocabulary (**T = 55**) than the average norm. The sample group also made fewer mistakes when being asked to reject a non-word as a fake word (**T = 45**). The results indicate that the entrepreneurs have a significantly better word related knowledge, thus giving a higher than average suggested IQ-level ($z = .9$, $\alpha = .01$).

The Maze-test

When performing more complex tasks such as those included in the two Maze-tests, the entrepreneurs seemed to move their strategies from focusing on accuracy, to focusing on speed. As the task within the Maze test (Visuo-spatial performance) became more difficult, the test participants' flexibility worsened, while at the same time the impulsiveness increased. The following results were attained from the Maze test: Performance **T** = 52, Accuracy preference **T** = 50, Flexibility **T** = 45, Impulsiveness **T** = 60, all of which flexibility was significantly lower than normal and the impulsiveness significantly higher than normal.

Self-efficacy test (self-rating speed, accuracy and performance before and after the test)

The majority of the entrepreneurs did not consider themselves as being nervous or under pressure, but reported that they had difficulties concentrating. In comparison with the norm the test participants to a larger extent considered themselves as faster than others in solving problems and performing tasks (1 SD) and at the same time being as accurate as others are. Since they consider themselves being faster than, but still as thorough as others, they judge their performance as higher than the norm but at the same time they report having a "bad performance day". The test participants who had notable concentration difficulties judged themselves as less accurate than others and were more likely to report having a bad day. Those who estimated themselves as faster than others did also consider themselves as being higher performers and were more satisfied with their performances.

After the test the participants tended to adjust their opinion of their performances on speed and on being better performers than others. Hence, the test subjects were not too bad at estimating their overall performance and the average overestimation was **.5 SD**. Thus, no significant relation between actual performance and estimated performance was found.

Over-all IQ (combined variable of three weighted measures)

The entrepreneurs had a higher IQ-level (116) than the norm (100), somewhat supporting the theories stating that entrepreneurs are on average more intelligent than others.

Control groups

In addition to providing comparisons with norm data for the results of the testing of entrepreneurs, relevant comparison data were available for two groups of subjects: (1) applicants to intermediate, junior or CEO positions in Swedish business companies, routed through a head-hunting agency (in the following denoted "executives", n = 40, age 23-44), and (2) subjects recruited for the study of cognitive sex differences from senior years of courses at the Lund university faculties of technology and law.). This group, comprising 16 women and 16 men, age 22 to 28, will be denoted "academics" in the following.

Results on the tests for the entrepreneurs, and for the comparison group of executives are displayed in the table below. The most salient difference versus norms for the entrepreneur group was obtained for focused attention (Fig. 9). This finding will be commented on in more detail later in the following section.

APT data (T-scores) for entrepreneurs (n=28) and executives (n=31)

	MEAN		SD	
	<i>Executives</i>	<i>Entrepreneurs</i>	<i>Executives</i>	<i>Entrepreneurs</i>
Simple RT	53,1	50,2	9,5	11,5
Complex RT	56,1	55,2	6,2	7,8
Sel. attent.	62,1	66,9	9,1	8,4
Verbal speed	64,9	56,6	4,9	4,6
Visuospatial skill	51,4	48,5	8,3	9,7
Short t. Ver-bal memory	56,8	52,9	9,3	12,5
Short t. Non- verb. Memory	58,6	57,0	9,0	8,0
IQ 2	121,4	116,9	8,7	10,0
IQ 3	118,5	117,0	11,2	13,4
Speed vs accuracy preference	56,6	52,7	10,0	8,6
Impulsive errors	50,1	50,0	7,5	6,4
Global vs sequential style	45,5	47,9	10,8	7,5
Flexibility glob → seq	50,8	50,6	10,5	8,5
Flexibility seq → glob	38,2	44,8	12,4	9,3
Executive consistency	38,6	35,0	14,2	13,4
Executive speed pref.	64,7	51,8	3,6	5,3
Subj rated speed pref.	54,0	51,5	8,7	9,7
Subj rated accuracy	52,0	47,5	8,2	11,0
Subj rated performance	56,0	53,0	9,8	8,0

Fig 9

Comparisons to the control group of academics yielded few, but still significant results. The academics had a higher IQ level (125) than the entrepreneurs (116). In terms of speed and accuracy the academics were both faster (678 Msec compared to 804 Msec.) and more accurate than the entrepreneurs. Also, the control group had a better vocabulary. In terms of overall performance the academics were approximately 1 SD better than the entrepreneurs were. In comparison to the control group of academics, the entrepreneur group was also less skilled in spatial tasks. Only on the variable measuring focused attention did the entrepreneurs outperform the academics.

5.1.1 Summary

The entrepreneurs did not differ significantly from others except in *focused attention* and *impulsiveness*. In addition some less significant variables such as lower degree of flexibility in complex task solving were observed. Entrepreneurs do seem to have a higher IQ-level than normal, but are less intelligent than e.g. executives, who often perform the same kind of tasks as entrepreneurs do.

5.2 ADHD-QUESTIONNAIRE

Out of 29 test participants twenty (20) were men and nine (9) women. Eight (8) had an academic exam, seventeen (17) had graduated from high school, while four (4) had not. The average age was 42 years (23-62).

There was a trend that dyslexics to a larger extent had ADHD (67 %), than non-dyslexics (40 %).

Nine (9), out of 29 reported having strong symptoms of ADHD. An unexpectedly large portion of the sample (31 %) showed signs of ADHD, which should be compared with the population mean of 4 %. Interestingly seven (7) indicated sign of childhood ADHD, 13 had present ADHD, and thus (5) show strong signs of having present ADHD, without having had ADHD as children. Only one (1) of the participants had recovered from childhood ADHD.

Women entrepreneurs showed the same percentage of ADHD individuals, as men. Women are generally diagnosed with ADHD in a third (1/3) of the number of positive ADHD diagnosis for men. Thus, the results contradict the expected in comparison to the population mean. There was no relation between ADHD scores and age. Thus, there was no evidence of a generation effect. Some subjects reported current ADHD problems without having displayed childhood problems. There are several reasonable interpretations of this. One possibility is that they did have ADHD as children but had understanding and supportive parents. This minimized the negative consequences. Another explanation is under-reporting or forgetfulness – they had problems but have not included that in their narrative image of themselves. A third interpretation is that the current ADHD type problems are consequences of their life situation rather than a clinical diagnosis – as we found out during interviews and testing the entrepreneurs seem to have countless balls in the air at the same time – and they constantly have to monitor each of them. It is not difficult to understand that such a situation can induce inattention, irritability and working memory problems.

However, when adding the two categories of childhood- and present ADHD, more than half (>50 %) of the participants have had or have ADHD-related problems in comparison with expected ADHD of only 5 % of the population.

5.2.1 Summary

Out of 29 test-participants approximately 30% showed a tendency of or had fully developed ADHD, in comparison to the fraction of 4% ADHD individuals in the population. This fraction is much lower in socially well-adjusted groups – not more than 2%. This is a highly significant result indicating that entrepreneurs to a larger extent do suffer from ADHD than others do, however without developing negative social or professional complications.

6 ANALYSIS

6.1 DATA ANALYSIS

Have new evidence been found for supporting the theory of cognitive differences between entrepreneurs and non-entrepreneurs? This section aims at comparing the theoretical findings in order to be able to decide whether to accept or reject hypothesis posed in other studies.

Are entrepreneurs higher in overall IQ (i.e. both academic and practical IQ)?

The entrepreneurs had a higher over-all IQ-level than the population. The weighted IQ (practical - IQ2, and academic - IQ3) for the group was 116 to be compared with the population mean of 100. The academic IQ score did not include vocabulary to maintain fairness in the comparison with a group who had more academic training and no over-representation of ADHD and dyslexia. One of the entrepreneurs had the highest overall IQ assessed so far using the APT battery (153 – a woman). However, there were also a few entrepreneurs who had an IQ just under 100. So, high IQ is not a necessary condition for becoming an entrepreneur, but it helps. There are some points in comparing IQ2 and IQ3 between Entrepreneurs and Executives. We had IQ2 and IQ3 data for 28 + 31 = 59 subjects. If we limit the analysis to IQ scores over 130 (2 SD above norms), there were 18 observations – 9 for IQ2 and 9 for IQ3. Among these 18 observations, 12 were for entrepreneurs and 6 for executives. This difference is easy to interpret after inspection of plots between IQ2 and IQ3 within each group. There was a high correlation between IQ2 and IQ3 among executives ($r = .60, p < .001$). It was non-significant among entrepreneurs ($r = .27$). Thus, entrepreneurs more often have either a high IQ2 or a high IQ3. The IQ of executives is more homogenous (more or less of the same, Fig. 10)

Correlation of IQ 2 (practical intelligence) and IQ 3 (academic intelligence)

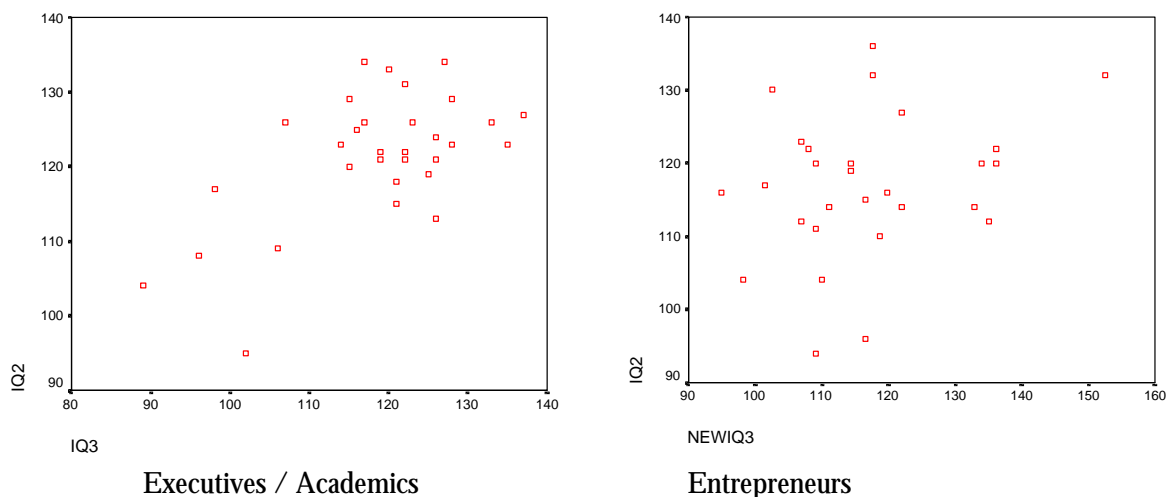


Fig 10

Are entrepreneurs particularly speedy?

The entrepreneurs were somewhat faster than the norm but slower than the comparison group of executives. The entrepreneurs showed an overall higher tendency to having an impulsive character, meaning that speed was preferred to accuracy and that the speediness, to some extent, was not calculated but a result of carelessness. This was particularly clear when confronted with the more complex tasks, where the entrepreneurs lost in speed as well as in accuracy while scores reflecting impulsive errors increased.

Do they have superior attention abilities?

Selective attention was much better for entrepreneurs than norm data. Therefore a separate and more detailed analysis of these data is warranted. It is noteworthy that four of the 29 entrepreneurs performed 3 SD above norms. The probability for one subject of 29 randomly sampled subjects of the population to perform on this level is approximately 2.5 percent (i.e. we need 40 consecutive samples of 29 subjects to find one performing on this level). The multiplied probability (four among 29) is 4 in ten million samples. It is obvious that this is a highly significant finding. The distribution is deviant with two outliers – inspection of the raw data verified that these two subjects, and only these two, did perform very poorly on both subtests of selective attention. Provided that we look into the remaining 27 subjects, which form a continuous and normal distribution, they performed 1.7 SD above norms as a group – also that a highly significant finding.

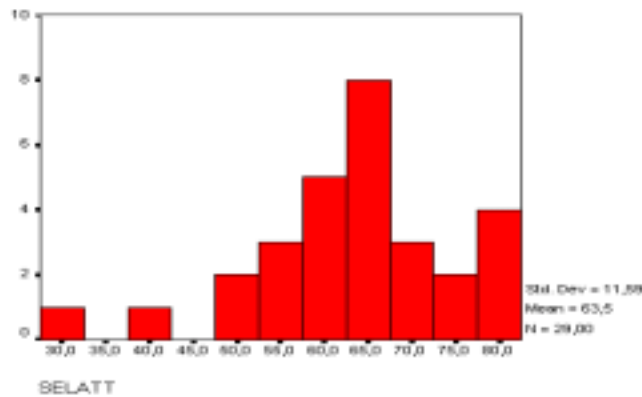


Fig 11

Overall, entrepreneurs performed somewhat better (by .4 SD) than the two other groups: a post hoc marginally significant difference that becomes significant for the theoretically relevant model (entrepreneurs perform better than the other two groups that perform on the same level). There was a significant speed difference in the global subtest: Entrepreneurs were fastest and executives slowest ($p < .05$ post hoc). Academics used a more global processing mode in the global subtest than the other two groups ($p < .05$ post hoc). Academics were considerably less accurate in the sequential subtest than the other two groups ($p < .001$ post hoc) at a small gain in speed (non-significant). There were no differences in terms of flexibility among the three groups of subjects. Summing up, all three groups performed much better than the norm, but entrepreneurs were still better. They were able to squeeze out more speed in both subtests without losing accuracy – actually they had the best accuracy figures in both subtests. Sex, dyslexia and ADHD did not affect any of the focused

attention test indices among entrepreneurs – in contrast to findings for other groups of subjects. A speculative hypothesis might be that ADHD among entrepreneurs is associated with the ability to hyperfocus.⁹

Are entrepreneurs more likely to take risks?

The entrepreneurs showed an overall higher tendency to be impulsive, meaning that speed was preferred to accuracy. *Except for focused attention results.* This result indicates that entrepreneurs are more likely to take risks since the lessened accuracy was not offset by an equal increase in speed, thus a risk of lower performance was taken.

Do they use specific problem-solving strategies?

The entrepreneurs did not seem to have a preference towards a specific strategy. There was a balance between global- and sequential strategies, which was identical to the population norm, nor was their executive performance above average. The major difference between the control groups was the entrepreneurs' inability to *change* strategies. Their flexibility was significantly lower than normal.

Are they keen and precise in terms of self-efficacy?

The entrepreneurs tended to overestimate their own performance when asked before the test. After the test they reevaluated their performance and lowered their expectations on their performance to a more moderate level. In comparison to the actual performance they actually underestimated their performance. Those who, in advance, considered themselves as overall better than other individuals and had a good vocabulary tended to underestimate their performance more than those who had a good actual performance on the spatial tests. These differences were non-significant.

6.1.1 Summary

Entrepreneurs differ cognitively from the general population, and to some extent from a group with similar background and professional experience, the executive group. Salient differences were, a less homogenous IQ profile, and a remarkable capacity to focus attention on a single task, in itself simple and boring but inviting a competition attitude. ADHD-individuals were also found to be highly over represented among the entrepreneurs. We therefore gained support for our main hypotheses;

There are differences in cognitive- and executive abilities between successful entrepreneurs and non-entrepreneurs.

Entrepreneurs with ADHD out of the sample group > 4%, the average for an unselected population.

6.2 EMPIRICAL ANALYSIS

This section will discern similarities between the results found in this study and other prior studies, thus supporting or rejecting the current scientific standpoints within different theoretical areas of entrepreneurship. Empirical conclusions will be drawn from the presented results.

⁹ This is a well known but anecdotal phenomenon observed by clinicians working with ADHD patients.

6.2.1 Focused Attention as a Result of Environmental Stimuli

The entrepreneurs' superior ability to focus attention on one task can be a reason for their success. It is possible that this aptitude makes them immune or less vulnerable to tiredness or environments that contain many potential distractions. Being able to select the relevant information, and at the same time not being disturbed by other irrelevant information is likely to be a necessity in venture creation.

The entrepreneurs were able to maintain both a high accuracy level and a high-speed level as long as the tasks presented to them were simple and guidelines were clear. As the tasks became more complex the entrepreneurs approached the demarcation line where the maintenance of speed compromises accuracy disproportionately. The level of flexibility was normal during the simple tasks but decreased significantly during the more complex tasks. This might indicate that entrepreneurs, when faced with new, complex problems, have a tendency to stick to their usual way of doing things, no matter if it is the most efficient one. Possibly this phenomenon can be related to the often-observed behavior among entrepreneurs, namely that they keep going no matter what the obstacles are until they reach their goals.

Individuals with ADHD tend to be stimuli driven. Environmental stimuli that are novel, varied and challenging increases the CNS arousal level, which is often sub-optimal for ADHD individuals, thereby inducing improved performance and subjective well-being. Once an individual experiences the first “kick” of something that share attributes with venture creation, it is likely that the individual will try to re-experience the kick – a learning loop is created, which will enforce the link between venture creation and well-being. Motivation is built by the expectation of well-being linked to the pleasure-generating environments and activities. This model suggests that an entrepreneur is not necessarily someone who has a well-specified purpose or goal when involving in venture creation. Rather, as many entrepreneurs state it themselves: “It is the road that makes the goal worthwhile”. This is in contrast to Wärneryd’s (1988) suggestion that a successful entrepreneur has a well-specified goal for her or his purposive actions. A successful entrepreneur is, then, someone who acts, through venture creation, in response to environmental stimuli. To apply the theory of stimuli-driven acting on entrepreneurs seems logical in light of our results of a high frequency of ADHD among our group of entrepreneurs. The entrepreneurs seem to look forward, motivated by different stimuli, and when acting upon these stimuli they can focus since they are motivated to do so. They may have an added advantage in such situations – their superior focused attention capacity, reminiscent of the clinical phenomenon denoted hyper-focusation. Obstacles are perceived as small, the increase in well-being is significant, the entrepreneurs keep going on, and on and on, where others would have failed or given up before long.

The motivation theory of entrepreneurship is thus highly relevant. The importance of motivation and need for achievement presented by Delmar (1996), Isachsen, (1996) and McClelland (1961) is supported but from a different angle. The motivation is not necessarily a means to obtain successful entrepreneurship, but rather a factor resulting from responding to the need of being stimulated and feeling well. The reaction to stimuli can vary, and the successful creation of a company or project can be considered as means of handling the never-ending need to respond to stimuli. Being a successful entrepreneur is considered the goal in the motivational theory of entrepreneurship, whereas we suggest that the goal is expected well-being via learning. The creation of a company demands continuous attention and engagement, and motivation is the driving force to further reactions to stimuli. In the following model we reformulate the

*According to
McClelland,
achievement is the
psychological
driving force for
economic growth.*

motivational model and draw up a new model of entrepreneurship including cognitive factors that characterize successful entrepreneurs.

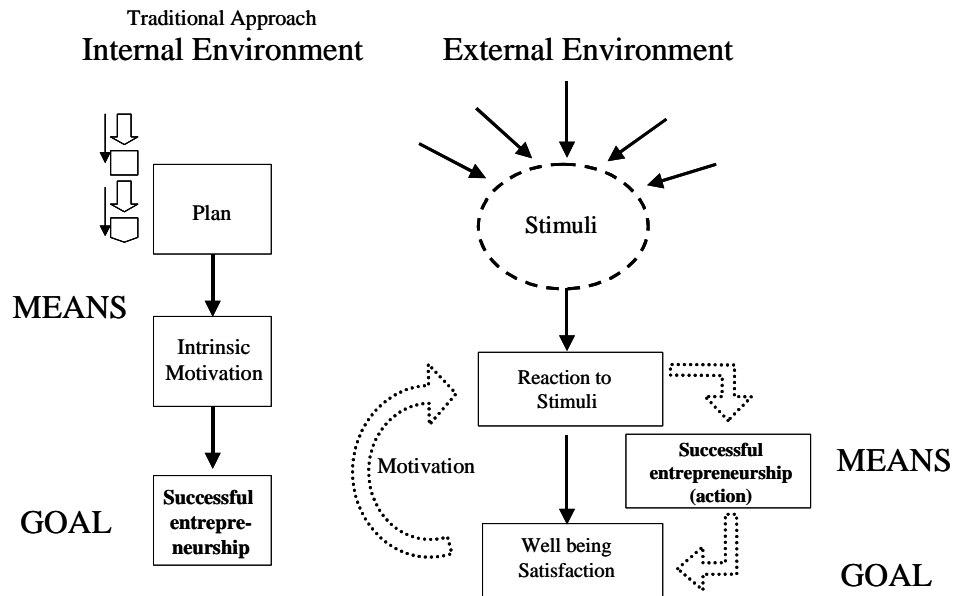


Fig 10

Levander & Raccuia 2000

6.2.2 *Uncalculated risk taking and lack of executive ability support theories of social skills and environmental influence*

The entrepreneurs' relatively poor flexibility and their reluctance to change strategy can be a consequence of the imprecise estimations of their own performance. It might even be because of poor self-efficacy that the entrepreneurs actually chose to become entrepreneurs. In cases where non-entrepreneurs, with good self-efficacy ability, are certain of not being able to perform a task, such as venture creation, successful entrepreneurs sees an opportunity. The test participants showed a tendency toward overestimating their performance before doing the test, something that supports the findings of Busenitz and Barney. The tendency to stick to intuitive and impulsive problem solution strategies increased as tasks became more difficult. It is possible that the entrepreneurs' inability to evaluate their current performance critically is one explanation of their lack of flexibility. Thus, uncalculated risks were taken because they overestimated their performance. This implies that the results of the Mullins and Forlani study (1988), which found that entrepreneurs are less inclined to take uncalculated risks than executives, was not supported.

Busenitz and Barney conclude that entrepreneurs are more overconfident than executives, thus making more risky decisions as a result of low self-efficacy

Palich & Bagby state that entrepreneurs are too forward-looking and optimistic, while as Timmons show that entrepreneurs have an ability to respond positively to challenges and learn from mistakes

Furthermore, the Austin maze test revealed that the entrepreneurs were significantly lower in consistency than the norm, meaning that the test participants were not learning from mistakes. This supports the study of Palich & Bagby (1995) who concluded that entrepreneurs are too optimistic and fail to learn from mistakes. The low consistency can be derived from poor planning, failing attention or working memory problems, but can also reflect a habitual and pervasive problem-solving style, in which error signals tend to be ignored and analytical rationality has a lower priority than instinct and gut-feeling. All these explanations are over-lapping, and well-known

clinical characteristics of the ADHD disorder. This line of reasoning is consistent with that the Stewart and Roth study (1999) of entrepreneurs, having a higher risk-taking propensity than non-entrepreneurs.

Obviously, many successful entrepreneurs are able to look upon obstacles as non-problems, thus dealing with the situation at hand immediately, without planning in advance. This ability in combination with the extreme ability of focused attention, and possibly in many cases additional kinds of cognitive abilities that do not show up in academic performance or conventional IQ tests (the low correlation between IQ2 and IQ3), makes the entrepreneurs able to concentrate and act efficiently. Thus, the results on executive ability obtained within the test that were significantly higher than average are probably a result of the entrepreneurs' speediness and perseverance. The planning deficit is probably the factor decreasing executive performance for more complex tasks to a moderate level, lower than what was expected. Our data suggesting that the entrepreneurs had some executive problems support the theories of social skills and entrepreneurial networks (Baron & Markman, 1998; Baron & Brush, 1998). Since the entrepreneurs themselves lack the ability to plan ahead for execution, it might be supposed that they succeed in venture creation by securing that people with planning- and control skills be part of their closest network. The above-presented findings of entrepreneurs being less skilled in planning, thus resulting in a lower executive ability, are also supported by the research conducted by Vassileva and Dock.

The Baron study indicates that the social side of life is of high importance for entrepreneurial success

Vassileva et al points out that adults diagnosed with ADHD display executive function deficits

6.3 DISCUSSION

The results and analyses presented above lend support to certain cognitive theories of entrepreneurial success. Our interpretation of the data is in line with important theories of motivation and social skills as well as theories of environmental influence, although we want to reformulate the mechanisms that generate motivation (the road rather than the end of the road). Prior assumptions (3.2.3), that there are a host of interacting factors influencing entrepreneurial success were supported, which was not unexpected. This invites continued attention to social skills and other widely recognized theories of entrepreneurial success, but also dissuades continued neglect of cognitive abilities in entrepreneurial research (fig. 11).

General model of entrepreneurial and business performance

source: F. Delmar

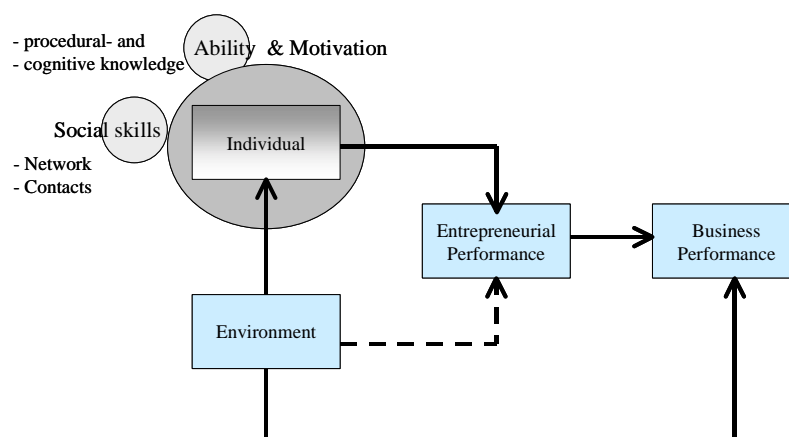


Fig 11

7 CONCLUSIONS

7.1 THEORETICAL IMPLICATIONS

Since the results show that there are significant cognitive differences among entrepreneurs and non-entrepreneurs, the current neglect of cognitive psychology in studies performed to identify what characterizes a successful entrepreneur should be replaced by an increased focus on cognition and practical intelligence. The model presented in the prior section represents a complementary model for analysis of characteristics of successful entrepreneurs and their behavior in venture creation.

7.2 PRACTICAL IMPLICATIONS

7.2.1 *Lack of certain cognitive abilities demands complementary talents*

Surprisingly, the entrepreneurs did not show such a high executive ability as initially expected. We assumed that success in venture creation was partly due to the entrepreneurs' extreme ability to effectively execute their ideas and turn them into prosperous projects. This assumption proved to be partly wrong, something that, to some extent, could be explained by ADHD-syndromes, resulting in a lack of planning skills.

Prior research has claimed that one single entrepreneur can never be ascribed to have created business success. Instead, a prospering company is often the outcome of an efficient *team* of entrepreneurs, who each possess distinctive skills that complement each other (3.1.1). Our findings support these assertions, meaning that entrepreneurs need to be aware of the fact that they should attract skillful people to be a part of their closest network at an early phase. Thereby, the entrepreneurs can concentrate on being innovators and stimulators while others care for the planning and execution. Venture capitalists should also be aware of this, making sure that the new ventures they invest in consist of efficient teams instead of focusing on the single entrepreneur.

7.2.2 *Sole focusing on social skills and social capital is not recommendable*

A comprehensive investigation of entrepreneurs' cognitive abilities will give venture capitalists / established firms more efficient tools for evaluating entrepreneurs in order to guarantee a sufficient level of abilities necessary for success. This study has verified that entrepreneurs do have extraordinary abilities to focus whole-hearted and solely on one task, meaning that they might become successful entrepreneurs even though they lack other abilities.

Many researchers (Hisrich & Jancowicz, 1990) have proven that social skills and personal chemistry is of importance for entrepreneurs' possibilities to raise money from venture capitalists.¹⁰ This indicates that many of the individuals given money for their business ideas might only be good "talkers" with likable personalities, but without any real knowledge or ability to become a successful entrepreneur. Since very few

¹⁰ See Baron & Brush. 1998.

venture capitalists in Sweden test the entrepreneurs to whom they give substantial financing, but instead trust their “gut feeling”, there is really no guarantee that the entrepreneurs have the necessary abilities in terms of cognition, intelligence and executive ability to become successful. Baron (1998) shows in a study that raters (business students and psychology students rated entrepreneurs’ business plan presentations) do perceive significant differences between the entrepreneurs in terms of eight factors. This analysis revealed two distinct factors that together accounted for 40,5% of the variance, namely perceived social skills (31,9%) and surprisingly; perceived intelligence (8,53%). Baron concludes that since social skills, social adaptability and social capital seem to play a very significant role for entrepreneurs’ chances of getting seed money, entrepreneurs with less social skills should be given lessons in how to better build their social capital. Otherwise, potentially successful entrepreneurs risk being rejected by venture capitalists on the basis of not being social enough. Another reasonable implication of this research, not mentioned by Baron, is to make venture capitalists aware of the fact that they make decisions on how well they “like” an entrepreneur, rather than on relevant information, such as cognitive abilities. A number of Swedish venture capitalists have recently acknowledged the importance of making judgments on who should get the money, and are now looking into possible solutions to avoid “talkers” and entrepreneurs with psychopathological traits.¹¹

7.2.3 Change of leadership as company structures grow and markets mature

The entrepreneur might not be the most suitable person to lead a former start-up company when moving into a more mature phase with less market uncertainty and a larger organization. As the environment becomes more predictable and secure, environmental stimuli will decrease resulting in a less motivated entrepreneur. There is thereby a risk that the entrepreneurial leader will become bored and unfocused since no longer exposed to challenging stimuli. As a result she or he is probably no longer the most suitable person to manage the company. This implies that venture capitalists and entrepreneurs at an early stage should agree on an appropriate exit or transfer for the entrepreneurs into performing other tasks, such as product development, a source of ideas or a specialist/expert/consultant.

7.2.4 Organizational aspects worth considering

If the entrepreneur’s success in venture creation is dependent on a challenging environment providing rich and varied stimuli, organizations should be organized accordingly. It is often said that an organization should be ad hoc structured and flat in order to generate new creative ideas, not to suffocate them. This might be true to some extent. On the other hand, if the stimuli-driven entrepreneur has to engage in all tasks concerning the company or project (e.g. even coffee making), as is the case in anarchy-like organizations, she or he is not likely to perceive this environment as stimulating. By consequence, their ability to focus decreases. This implies that ad hoc structures must be combined with some structure as to who does what, else the entrepreneur will have to engage in non-stimulating activities, which is inefficient.

¹¹ E.g. the Swedish venture capitalist IT Provider

7.3

SUGGESTIONS FOR FURTHER RESEARCH

By further studying and mapping the factors that can be considered as positive stimuli factors for entrepreneurs, companies can create suitable working environments where entrepreneurial behavior can flourish, thus reducing the risk of valuable intrapreneurs leaving their organizations. The research should mainly involve testing entrepreneurs in more realistic situations than those used in this study. There is also a macroeconomic winning in a further investigation of entrepreneurial stimuli. Some individuals with ADHD, in their reactions to constantly changing stimuli, are perceived as a disturbing element in organizations. By directing the creativity in the right direction, these individuals can become a valuable source of innovation and thus contribute to sustainable economic growth. As mentioned in the introduction of this thesis: *“The problem of explaining why some succeed while others fail is crucial to the study of economic development”* (Casson, 1981).

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8.2 LECTURES & SEMINARS

Kawasaki, Guy. Lecturer at the First Tuesday Conference in Stockholm, Sweden. August 1st, 2000.

9 APPENDIX

9.1 APT TESTS AND INDICES

A short description of the test sessions follows below.

REACTION TIME SIMPLE

The average reaction time for a simple task with only one response alternative is approximately 200 Msec with an interindividual SD of 30 Msec for an average, healthy, age 18-45 person. Simple reaction time is one important aspect of cognitive capacity; it is better to be fast. Its correlation with overall cognitive capacity is around .25, i.e., slightly less than 10% of a person's intelligence is built up by this factor of 'speediness'.

REACTION TIME COMPLEX

The average reaction time for more complex stimuli increases by the logarithm of the number of response alternatives. This increase may be more pronounced for some individuals, i.e., when processing demands increase, their response times slow down disproportionately.

SELECTIVE ATTENTION

The k-test is a continuous performance test of selective attention. The task is to decide if the letter k is displayed, among distracters, on the monitor screen. The test is presented in two versions, with filled squares as distracters and with other letters as distracters. Performance on the k-test is calculated as the mean of speed and accuracy indices in these two versions, the mean is based on four measures. Selective attention is a basic cognitive ability that reflects the ability to attend continuously to a rather dull repetitive task, and maintain a high degree of concentration and motivation over time. In addition to the performance information, some strategy information is also extracted (Speed vs. accuracy, Global vs. sequential style and strategy flexibility).

K-TEST SPEED, SIMPLE DISTRACTERS

The k-test is a continuous performance test of selective attention. The task is to decide if the letter k is presented on the monitor screen. In this version, distracters are filled squares, i.e., characters that are very dissimilar to the letter k. Therefore, a global processing approach will yield the best overall performance (a marked increase in speed and a somewhat increased risk of making errors). A test time of 5 minutes usually yields approximately 130 responses to analyze. Other aspects of test performance (than speed) are considered in k-test performance, speed/accuracy preference, global/sequential style and strategy flexibility indices.

K-TEST SPEED, LETTER DISTRACTERS

In this version, distracters are other letters, i.e., characters that may be very similar to the letter k. Therefore, a sequential processing approach will yield the best overall performance because a global approach will result in a marked increase in the number of errors. Since the response times are more than double that of a global processing mode, a 5-minute test session yields approximately 80 responses to analyze.

META ANALYSIS OF SPEEDINESS

The estimation of speediness is based on a regression equation taking all non-specific speed indices into account (i.e. indices that do not represent a specific skill, for instance

vocabulary or reasoning). Complex reaction time is one important aspect of cognitive capacity; it is better to be fast. In normal subjects the correlation between speed in a simple and speed in a complex task is very high. For some subjects, for instance brain lesion patients or chronic alcoholics, the simple reaction time may be normal, but the complex one markedly increased. The average correlation between response speed (simple as well as complex) with overall cognitive capacity is somewhat below .30, i.e., around than 10% of a persons intelligence is built up by this factor of 'speediness'.

WORD TEST, VOCABULARY AND SPEED

Language skill is one of the four major cognitive skills. These skills are assessed by a lexicon decision task, in which stimuli (four-letter combinations) represent one of four classes of stimuli: High-frequency words, Low-frequency words, Pronounceable non-words, and Non-pronounceable non-words. One aspect of the language skill is vocabulary. Vocabulary is assessed using the ratio of correct vs. incorrect responses to Low-frequency words and Pronounceable Non-words – this index correlates approximately .75 with a conventional vocabulary test. In addition, speed (median response times to the four word categories) and strategy aspects (impulsive/ reflective style, affirmative or negative responses when uncertain) are analyzed.

VISUOSPATIAL SKILL

Visuo-spatial skill is one of the four most important cognitive skills. It reflects the ability to orient in space, translate a map to terrain, imagine what a 3-dimensional structure would look like from another angle, and visualize hidden gestalts or patterns in pictures. Thus it is kind of an engineering skill. Men are considerably more skilled than women in that respect (group differences are around .7 SD). This cognitive skill is assessed by the Elithorn Maze test, in two versions, **with** and **without partial solution information**. The former version invites a sequential strategy. When the solution information is withheld it is rational to shift to a more global processing style. Performance in the test is calculated by summing speed and accuracy indices with equal weight. In addition, information about the subject's preferred problem solving strategy is obtained: speed/accuracy, impulsive/reflective, global/sequential, and strategy flexibility (to change strategy when test conditions change).

SHORT TERM MEMORY

The short-term memory capacity is assessed by the Digit span test. In addition to being a test of short-term memory (working memory of the phonological loop type), it also assesses general intelligence and ability to concentrate. Thus, it is to some extent a compound measure.

AUSTIN MAZE TEST

In this test, the task is to find a pathway out of a maze pattern. The pathway is invisible. The solution process can be characterized as a trial and error process, where the subject at all times have to be aware of and register what s/he has done so far, and exercise consistency and a balanced speediness when testing unknown alternative pathways. The test loads heavily on working memory of the scetch-pad type. Overall, this is a compound test that loads on several frontal functions, i.e. executive functions. It requires a special kind of awareness that can be described as being able to remember to remember. Preservations and impulsiveness (which represent specific executive problems) leads to marked impairment in performance. Poor performance in the AUSTIN test, particularly if performance is OK in other tasks, suggest that the subject has specific frontal/executive problems, which will interfere with problem solving 'on ones own', and without help and structure from others. On the contrary, it has been

shown that a group of subjects applying for intermediate leader positions at a head-hunter's agency did have above average IQ scores but performed still better than expected on the Austin maze test. This can be explained by the fact that an executively competent person realizes that there are better than chance possibilities to select the correct next step – and these chances increase the closer to the exit you come. Two separate executive problems are assessed by the indices 'Executive consistency' and 'Executive speed'.

SPEED VS ACCURACY PREFERENCE

In most APT tests, unspecific instructions are given that speed as well as accuracy matters. Therefore, an individual gives priorities according to her/his specific preference. In most APT tests performance is defined as the vector sum, with equal weight, of speed and accuracy. These tests, then, are specifically well suited to calculate a score reflecting the balance between these two factors. The actual score is the average of the speed/accuracy trade-off index for each of these tests. In groups of normals there is a weak to moderate correlation among these separate measures. In some pathological groups with marked executive problems (for example schizophrenics), individuals are not able to formulate and follow a consistent strategy, and may use completely different priorities over the different tests. The speed preference index should be compared to the individual's self-image in this respect, which may reveal another executive problem: lack of awareness and self-monitoring competence.

IMPULSIVE VS REFLECTIVE STYLE

In some of the APT tasks, errors are produced not because of a systematic preference for speed but because of sloppiness and excessive stimulus dependence (i.e. the presenting characteristics of a stimulus is given much greater weight for action than goal-directness). In extreme form this is seen in the utilization syndrome of patients with frontal lesions. This index is built up of: (1) Crossed responses and failed response inhibition in the reaction time tasks; (2) A high ratio of rub-outs and a long check time in the maze test; and (3) Errors for the two simple stimulus categories in the Word test (High-frequency words and Non-pronounceable non-words). In previous research this type of strategy index has been denoted as reflecting a dimension of Impulsive/Reflective cognitive styles. There is a moderate correlation among the separate indices building the APT index, i.e. subjects tend to display the same behavior across tests.

GLOBAL VS SEQUENTIAL STRATEGY

For some APT tests, the preference for speed over-rides the distinction between a global parallel type of processing and a serial one. In the k-test, these factors seem to be independent, probably reflecting that subjects who use a global strategy successfully actually has a competence to do so (which does not preclude that some subjects use a global strategy because they do not care if they are making errors). The same reasoning applies to the maze test. This index is based on the response times in the k-test to items with k present and k not present, and the maze test ratio of Processing speed vs. Inspection speed. Using a global strategy in the K-test, the time to detect k and to conclude that there is no k are equal, i.e. a ratio of 1.0. For a pure sequential search strategy, the time to find k is half of that not to find k, i.e. a ratio of .50. The index is calculated as the mean of this yes/no ratio for the two k-tests and the maze test index with equal weight.

STRATEGY FLEXIBILITY IN THE K-TEST

In the first presentation of the k-test, distracters are filled squares, i.e. very dissimilar to the letter k. This invites a global strategy. In the second presentation, distracters are other letters, of which some are very similar to k (h, b). This necessitates a sequential strategy. The executively intact subject adjusts her/his strategies accordingly. In current research, several groups of criminals have displayed a marked and note-worthy inability to do so. Also some dyslexics appear to have a similar problem, without having any criminal propensity or personality disorder. Probably there is a common underlying factor, which has connections with a childhood history of conduct disorder, problems in forming Gestalt percepts, and possibly hemisphere interconnection problems. Those with impaired flexibility appears to decode letters as shapes rather than letter symbols, and are stuck in a right-hemisphere type of global strategy also for letter distracters.

STRATEGY FLEXIBILITY IN THE MAZE TEST

The Elithorn Maze test is presented twice, first with partial target information, then without target information. The first subtask invites the use of a sequential strategy, the second one a global strategy. The executively intact subject adjusts his strategies accordingly. If s/he (who more often is a she in this context) has a low visuo-spatial competence, there is actually an inverse change, i.e. the subject becomes still more sequential in Subtask 2.

EXECUTIVE CONSISTENCY (AUSTIN TEST)

In the Austin maze test, one has a certain number of tries to learn the hidden pathway to the exit. Some people are consistent in their learning, i.e. they use information economically, others repeat errors several times. This index reflects the consistency with which a subject tries to find the pathway by trial and error. A subject who is impulsive, or preservative, or who speeds through the task not paying attention to what s/he is doing will have a high score on this index. The index is uncorrelated with the performance and the speed index.

EXECUTIVE SPEED (AUSTIN TEST)

There is a time limit in each node, and a time limit for the total test. An executively conscious subject will understand that and aim for a good balance between the means of having enough trial episodes and enough time in each node to be able to store information. The design of the test results in a fairly high correlation between speed and overall performance. This index is most interesting in picking out subjects who become ambivalent in some nodes and do not use time efficiently (for instance those who have time errors, which are counter-productive).

SELF-RATINGS SPEED

Subjects have an opinion on their strengths and weaknesses. A well-functioning person displays a good match between his self-image and objective performance. If not, there may be an executive or a psychiatric problem. This item reflects the subject's opinion on his speediness and should be compared to the objective speed indices and her/his actual speed preference.

SELF-RATINGS ACCURACY

This item reflects the subject's opinion on his accuracy-mindedness and should be compared to the objective accuracy indices, and the number of impulsive errors.

SELF-RATINGS PERFORMANCE

This item reflects the subject's opinion on his overall performance and should be compared to the objective performance indices.

