

A STUDY IN PROBLEM SOLVING IN THE ENGINEERING SCIENCES

by

Karen Deborah Kleinot

Mini-Dissertation

In partial fulfilment with the requirements for the degree of

MAGISTER ARTIUM

in

COUNSELLING PSYCHOLOGY

FACULTY OF HUMANITIES

at the

UNIVERSITY OF PRETORIA

Supervisor: Ms. E. Du Preez

June 2004

ACKNOWLEDGEMENTS

This research could not be completed without the support and co-operation of various individuals.

My thanks to the Department of Student Support for allowing me to utilize the data specifically Prof. Jacobs, Dr Du Toit, Ms Ngcuka. Special thanks to Ms Kruger and Mr.J. Du Toit for assisting in the gathering of the data.

The Faculty of Engineering for their co-operation in this research.

The University of Pretoria statistics department for their willingness to analyse and assist in the statistics specifically Ms Owen.

Vir my mentor vir haar geduld, ondersteuning en aanmoediging. Dankie dat jy hierdie entjie van die pad saam met my geloop het.

To the members of the W.W.C.and friends, specifically Commissioners. Vanessa (Panther) Pather, Nerine (take five steps back) Kahn and Jeanne (its outrageous) Gaylard and Glenda van Huyssteen for providing sustenance, support and caring.

My family, in particular my parents who instilled in me a thirst for knowledge and tolerance. To my brother Jonathan, and Leanne for their love and encouragement and sustaining me through some difficult moments.

For all those who showed me a path with heart specifically Myrna Wajsman-Lewis and Greg Lewis.

ABSTRACT

This study investigated the link between creative thought and intuition. These concepts were defined in terms of two psychometric tests used to measure personality and interest. The two tests used were the 19 Field Interest Inventory (19FII) and the Jung Personality Questionnaire (JPQ). Intuition was measured on a continuum in terms of Jung's conceptualisation of intuition-sensation. Creative thought was conceived as both a cognitive and an unconscious process. The research was quantitative in nature. A comparison was done between the scores obtained on the personality questionnaire (JPQ) and the interest inventory (19FII) in order to determine if there was a link between intuition and creative thought. These results were inconclusive. Thereafter the study investigated whether the subjects enrolled for an engineering degree who used intuition as their dominant auxiliary function performed well in a course designed to promote creative thought. The results were inconclusive and this might be due to the small sample group and numerous variables that were not controlled.

Key words: Jung, Intuition-sensation, intuition as cognitive conscious and unconscious function, creative thought, stages in problem-solving, information processing, 19 Field Interest Inventory (19FII), Jung Personality Questionnaire (JPQ).

OPSOMMING

Hierdie studie ondersoek die verband tussen kreatiewe denke en intuïsie. Hierdie konsepte is gedefinieer in terme van twee psigometriese toetse wat gebruik word om persoonlikheid en belangstelling te meet. Die twee toetse wat gebruik was is die Negentienveld-belangstellingsvraelys (19VBV) en die Jung-persoonlikheidsvraelys (JPV). Intuïsie is op 'n kontinuum gemeet in terme van Jung se konseptualisasie van intuïsie-sensasie. Kreatiewe denke is as beide 'n kognitiewe en emosionele proses bedink. Die navorsing was kwantitatief. 'n Vergelyking is gemaak tussen die tellings wat verkry is van die persoonlikheidsvraelys (JPV) en die belangstellingsvraelys (19VBV) om te bepaal of daar 'n verhouding was tussen intuïsie en kreatiewe denke. Die bevindinge was nie oortuigend nie. Daarna het die studie ondersoek ingestel of deelnemers wat inskryf vir 'n ingenieurs graad, wat intuïsie as hul dominante ondersteuningsfunksie gebruik, goed gedoen het in 'n kursus wat ontwerp is om kreatiewe denke te bevorder. Die resultate was nie oortuigend nie, en dit kan wees as gevolg van die klein steekproef grootte en verskeie veranderlikes wat nie beheer is nie.

Sleutel terme: Jung, Intuïsie-sensasie, intuïsie as 'n onbewus en bewus kognitiewe funksie, kreatiewe denke, stappe in probleem-oplossing, informasie prosessering, Negentienveld-belangstellingsvraelys (19VBV), Jung Persoonlikheids Vraelys (JPV).

Contents

Chapter One: Introductory Orientation

| | |
|--|----|
| 1.1 Introduction | 1 |
| 1.2 Orientation to creative thought or problem solving and intuition | 1 |
| 1.3 The general attitudes of Extraversion and Introversion | 2 |
| 1.4 The Functions | 3 |
| 1.5 Awareness of the problem | 4 |
| 1.6 Statement of the problem | 5 |
| 1.7 Rationale of the study | 5 |
| 1.8 Clarification of concepts | 6 |
| 1.8.1 Sensation | 6 |
| 1.8.2 Intuition | 7 |
| 1.8.3 Creative thought | 9 |
| 1.9 Aims | 10 |

Chapter Two: Literature Review

| | |
|--|----|
| 2.1 Introduction | 11 |
| 2.2 Creative thought | 12 |
| 2.2.1. Creative thought as a cognitive process | 13 |
| 2.2.1.1 Problem finding | 13 |
| 2.2.1.2 Information processing | 16 |
| 2.2.1.3 Category selection combination and re-organisation | 17 |
| 2.2.1.4 Evaluation, solution implementation and monitoring | 20 |
| 2.3 Factors influencing creative thought | 22 |
| 2.3.1 Fluency, Flexibility and Originality | 22 |
| 2.4 Creative thought as an Unconscious process | 24 |
| 2.5 Creative thought in science | 26 |
| 2.6 Criticism of creative thought | 28 |
| 2.7 Summary | 30 |
| 2.8 Intuition as a conscious process | 31 |
| 2.8.1 Introduction | 31 |
| 2.8.2 Intuition as behaviour | 33 |
| 2.8.3. Intuition as a cognitive function | 34 |
| 2.8.4 Intuition and attention | 35 |
| 2.8.5 The neurological link to Intuition | 37 |
| 2.9 Intuition from an unconscious viewpoint | 38 |
| 2.9.1 Jung on Intuition | 38 |
| 2.9.2 Intuition from a Phenomenological and Metaphysical viewpoint | 41 |
| 2.10 Intuition in science | 43 |
| 2.11 Aesthetics and Intuition | 45 |
| 2.12 Criticism of Intuition | 45 |
| 2.13 Summary of Intuition | 47 |

Chapter Three: Methodology

| | |
|---------------------|----|
| 3.1 Introduction | 50 |
| 3.2 Research design | 50 |

| | |
|---|----|
| 3.2.1 Population | 50 |
| 3.2.2 Psychological Instruments | 52 |
| 3.2.3 Data Analysis | 52 |
| 3.3 Psychometric instruments | 53 |
| 3.3.1 Jung Personality Questionnaire | 53 |
| 3.3.2 Research relevant to the Jung Personality Questionnaire | 55 |
| 3.3.3 Evaluation of the JPQ | 58 |
| 3.3.4 The 19 Field Interest Inventory (19FII) | 59 |
| 3.3.5 Research relevant to 19FII | 60 |
| 3.3.6 Evaluation of the 19 Field Interest Inventory | 62 |
| 3.4 Conclusion | 63 |

Chapter Four: Analysis of Results

| | |
|--|----|
| 4.1 Introduction | 64 |
| 4.2 Results of the data | 64 |
| 4.3. Chi-squared tests | 65 |
| 4.3.1. Science and Intuition and Sensation | 65 |
| 4.3.2 Numerical Interest and Intuition and Sensation | 66 |
| 4.3.3 Creative Thought Intuition and Sensation | 67 |
| 4.4 Spearman's Correlation Coefficient | 68 |
| 4.5 Central Limit Theorem | 69 |
| 4.6 Analysis of variable percent | 70 |
| 4.6.1 Spearman's Correlation Coefficient | 71 |
| 4.6.2 Summary | 71 |
| 4.7. Discussion | 72 |
| 4.7.1 Creative thought as a cognitive process | 72 |
| 4.7.2 Creative thought as and unconscious process | 74 |
| 4.7.3 Summary | 76 |
| 4.7.4 Intuition as a conscious process | 77 |
| 4.7.5 Intuition as an unconscious process | 78 |
| 4.7.6 Intuition as a phenomenological and metaphysical process | 79 |
| 4.7.7 Intuition in science and intuition in aesthetics | 80 |
| 4.7.8 Summary | 80 |
| 4.8 Conclusion | 81 |

Chapter Five: Conclusion

| | |
|--|----|
| 5.1 Introduction | 82 |
| 5.2 Hypothesis | 82 |
| 5.3 Rationale for the research | 82 |
| 5.4 Summary of results | 83 |
| 5.5 Problems with the data | 83 |
| 5.6 Evaluation of the research | 84 |
| 5.6.1 Shortfalls of the study | 84 |
| 5.6.2 Shortcomings with the psychometric tests | 87 |
| 5.6.3 Recommendations | 88 |
| 5.7 Conclusion | 89 |

| | |
|------------|----|
| References | 91 |
|------------|----|

LIST OF TABLES

| | |
|--|----|
| 1. Table 3.1 Experimental population | 51 |
| 2. Table 3.2 Target population | 51 |
| 3. Table 3.3 Sample population | 51 |
| 4. Table 4.1 Frequency distribution and Chi-squared test of intuition and sensation versus interest | 66 |
| 5. Table 4.2 Frequency distribution and Chi-squared test between intuition and sensation versus numerical interest. | 67 |
| 6. Table 4.3 Frequency distribution and Chi-squared test of intuition and sensation versus creative thought interest | 68 |
| 7. Table 4.4 Spearman correlation coefficient | 69 |
| 8. Table 4.5 Simple statistics: Means and median | 70 |
| 9. Table 4.6 Analysis variable: Percent and the means | 71 |
| 10. Table 4.7 Spearman correlation coefficients | 71 |

CHAPTER ONE

INTRODUCTORY ORIENTATION

1.1 INTRODUCTION

The aim of this study is to investigate the relationship, between intuition and sensation, as conceptualised by Jung (1923a), and creative thought or problem solving as conceptualised by cognitive and psychoanalytic theorists (Freud, 1908, Houtz, 1994; Jung, 1923b, Kris, 1952; Mumford, 1988). A brief orientation to the concepts of creative thought and intuition will follow. Thereafter the problem will be discussed and the concepts of creative thought and intuition sensation will be clarified.

1.2 ORIENTATION TO CREATIVE THOUGHT OR PROBLEM SOLVING AND INTUITION

Creative thought has been viewed as either falling along a continuum of cognitive thought, or as two different modes of thought, conscious and unconscious (Bastick, 1982). Mumford (2001) views creative thought as a cognitive function separate from intuition or intuitive thought. Authors such as Rothenberg and Hausman (1976) view creative thought as having two components a cognitive and an unconscious element.

It has been suggested that cognitive functions range from intuitive to analytical thinking (Brunswick, 1966 as cited in Bastick, 1982). This author regards most thinking as quasi-rational, that is, consisting of a mix between intuition and analysis. He suggests that thinking that falls toward the intuitive end of the spectrum is unaided, perception-like thinking. It is in this mode of thinking that the individual does not consciously impose transformations on information. Thus, it is an unconscious and secondary process (Rothenberg & Hausman, 1976). Bastick (1982) suggests that an intuitive mode of thought is used in problem solving when analytical or previous methods are unavailable.

Creative thought is often coupled to intuition, although the nature of the relationship is not clear. The distinction between creative thought and intuition is made in order to facilitate understanding of the concepts, as there is a lot of overlap between these ideas.

1.3 THE GENERAL ATTITUDES OF EXTRAVERSION AND INTROVERSION

In order to understand the concept of intuition a brief discussion on intuition-sensation and the general attitudes that influence these functions, as conceptualised by Jung (1950), will follow. These general attitudes are relevant as they influence the manner in which individuals perceive and process information. This is related to the functions of intuition and sensation.

According to Jung (1923a) individuals develop general attitude types known as introversion or extraversion. These attitudes are influenced by the individual's relationship to a significant person or thing that is the centre of another's drives or feelings (St Clair, 1980).

Spoto (1995) proposes that the introvert perceives the object as taking energy away from his/her subjective world (inner world); as a result the individual withdraws energy from the object in order to prevent it from gaining influence or control. Consequently introverts tend to be more independent and idea oriented, they receive stimulation from their subjective inner world (Spoto, 1995).

The extravert's position in terms of the object is that he /she invests energy in the object (Jung, 1923a). According to Spoto (1995), the extravert finds the object fascinating and valuable, consequently his/her relationship to the world is open and active. The extravert receives stimulation from outside and may feel pulled into the world, attempting to do many things simultaneously (Spoto, 1995). Spoto (1995) suggests that extraverts want to influence others as well as their environment, and, they at the same time, influenced by their environment.

1.4 THE FUNCTIONS

Jung (1954) went on to explain that individuals also develop characteristic ways of using the conscious and unconscious. This refers to both the general attitudes and the rational and irrational functions. That is, the primary manner in which the individual perceives and judges the world around him/her.

There are four functions namely, thinking, feeling, sensation, and intuition (Jung, 1923a). The superior functions are characterised by confidence, preference, getting results, and comfort (Spoto, 1995). The functions that this research will focus on are those of sensation and intuition.

Jung (1923a) named these functions irrational. They are concerned with the evaluation and the processing of information in a non-intrusive and unbiased manner (Spoto, 1995). Sensation is concerned with using the senses to perceive and interpret the world. Intuition is connected to the unconscious and is instinctive (Spoto, 1995). Intuition takes in information from a global perspective in order to obtain a sense of the whole or bigger picture (Bastick, 1982). According to Storr (1973) the intuitive person has hunches about things and is concerned with possibilities rather than how things are in the present. If intuitive people are more open to possibilities it is possible that problem solving may be easier for them.

1.5 AWARENESS OF THE PROBLEM

It is apparent from the amount of students visiting the Department of Student Support at Pretoria University, that large numbers (837) of students sought career counselling during 2000 to 2002 (Departmental Yearly Reports 2000-2002). The students undergo a battery of tests aimed at providing guidelines for possible fields of study. These tests include the Jung Personality Questionnaire (JPQ), South African Vocational Interest Inventory (SAVII), Senior Aptitude Test (SAT), and the 19 Field Interest Inventory (19FII).

The researcher became aware of the problem relating to creative thought and intuition, through feedback sessions and informal discussions with colleagues about the results obtained on the JPQ and the interest questionnaires. It was apparent that both creative thought and intuition impact on the choice of career. From the amount of students tested at the Department for Student Support during 2000-2002 it is clear that many students are uncertain about their direction of study.

Many students have no clear idea about their interests or abilities. This confusion is further compounded by the fact that many students lack self-knowledge about how they interact with others and how they make decisions (Sharf, 1997). These two factors are important in career choice as they integrate personality and ability. Other factors such as limited financial resources and parental pressure add to the pressure to choose correctly (Sharf, 1997)

Factors that may also influence career choice are high personal expectations, peer pressure, parental pressure and limited financial resources (Sharf, 1997). Thus, there is no small amount of pressure on the individual to choose correctly (Hartung, 2002)

The final choice is important as it impacts on the student's career. The choice influences the direction and duration of study. Thus if the individual makes an incorrect choice it has far reaching consequences. Accordingly it is important to choose correctly and thereby avoid the loss of financial resources and time.

1.6 STATEMENT OF THE PROBLEM

The research problem is defined by the following research questions:

Question 1

Is there a correlation between intuition-sensation as measured by the Jung Personality Questionnaire and Creative Thought in terms of the items creative thought, science, and numerical in the 19 Field Interest Inventory?

Question 2

Are the scores on the JPQ predictive of performing well in the engineering course an *Introduction to Innovation*, a compulsory course for all the engineering fields at the University of Pretoria, involving a high degree of creative thought?

1.7 RATIONALE OF THE STUDY

Intuition is involved on many levels from problem solving to the act of creating and day to day living (Bastick, 1982; Runco, 1994). The word intuition has many meanings for varying contexts and people. It is this lack of definition that has shrouded this concept in mystery. The early debate between the Gestalt psychologists and the Behaviourist School about the meaning of Intuition versus Insight, created confusion, and as such very little research, exists in this area (Bastick, 1982; Kohler, 1929; Westcott, 1968).

According to Bastick (1982), most of the literature and experiments dealing with intuition do not focus on the applications of intuition in the sphere of education and science. According to Bruner and Clinchy (1966), students are not encouraged to use their intuitive ability and, indeed, are only taught analytical approaches.

Research is thus needed to identify the intuitive thinker and establish conditions under which intuition operates (Bastick, 1982). This in turn will assist the individual in making the correct decision in terms of career path and field of study (Paul, 1993).

1.8 CLARIFICATION OF CONCEPTS

People experience their world and process information in a variety of ways. This study will examine the irrational functions of intuition and sensation (Spoto, 1995). Sensation and intuition are irreconcilably different because of the manner in which information is absorbed and processed (Spoto, 1995)

1.8.1 Sensation

Sensation according to Jung (1923a) occurs on a conscious level. That is, information is taken in via perception. The concept sensation is based on perceiving information through the physiological senses, i.e. seeing, hearing, touching, smelling, and tasting (Jung, 1923).

According to Jung (1923a), sensation is conditioned by the object and the interpretation attached to the perception of an object depends on the subject's relation to the object, as well as the objects' existence in external reality. The relation of the individual to the object is influenced by his/her general attitude, either extravert or introvert (Jung, 1923a).

Objects release sensation and therefore impinge on our consciousness and are accepted into consciousness irrespective of whether the sensations are compatible with reasoned judgement or not (Jung, 1923a).

According to Jung (1923a), the strength of the sensation and its value is conditioned by its objective qualities for the extravert. From an introverted position, sensation is related primarily to the subject and then to the object (Jung, 1923a).

The individual perceives an object through his/her senses but is mostly concerned with his/her subjective perception of the object (Jung, 1923a). It is this focus on the object from a subjective view that gives rise to alternative ways of viewing the world, which is not merely a product of consciousness (Jung, 1923a). Jung (1923a) suggests that in this case sensation may be linked to the collective unconscious.

According to Jung (1923a), sensation that is subjective takes in the background of the physical world rather than its surface. The material issue is not the external reality of the object but the reality of the subjective factor (Jung, 1923a). Jung (1923a) suggests that the subjective factor consists of

primordial images (i.e. the collective unconscious), which together with the subjective reality is a psychic mirror world to the external world.

Introvert sensation conveys an impression of the object along with an age – old subjective experience (collective unconscious) (Jung, 1923a). This impression also contains possible future events (Jung, 1923a). The extrovert experience of sensation focuses on a momentary fleeting existence of things (Jung, 1923a).

1.8.2 Intuition

According to Jung (1923a), intuition is the opposite of sensation. Jung (1923a) conceptualised intuition as a function that facilitates perceptions via the unconscious.

Authors such as Glick and Lockhart (1995) suggest that intuition has an emotional component and is dependant on past experiences as well as the present situation that the individual finds himself/herself in. Damasio (2001) suggests that intuition depends on physiological functions. Authors such as Bastick (1982), Bohm (1998), and Mindell (2000) suggest that there is an emotional element to intuition, feeling, and empathy as well as an altered state of consciousness that is close to hypnosis.

From the introverted attitude, intuition focuses on inner objects (Jung, 1923a). These inner objects are psychological and do not necessarily exist in physical reality (Jung, 1923a). These objects comprise subjective images of things, which determine the contents of the unconscious and collective unconscious Jung (1923a) suggests that introverted intuition perceives all the surrounding processes of consciousness with approximately the same differentiation that extraverted sensation senses outer objects. Unconscious images attain the dignity of things or objects for intuition.

According to Jung (1923a), the unconscious is connected to inner psychic transformations and to current events. He suggests that introverted intuition

through the perception of inner processes provides information that may provide understanding of general occurrences. It is this constellation of information that, according to Jung, can foresee new possibilities in a more or less clear outline as well as the event, which later transpires.

Intuition from the extraverted position focuses on external objects (Jung, 1923a). Intuition is thus an active and creative process that builds on the object as much as it withdraws energy from the object. It is suggested that the main function of intuition is to transmit perceptions of relations and conditions and images. Jung (1923a) proposes it is only through the function of intuition and the correlating suppression of the other functions that the network of relations and images are perceived.

Intuition is therefore concerned with the seeking out of the greatest possibilities in an objective situation. It is thus always seeking outlets and fresh possibilities in external life (Jung, 1923a).

1 8.3 Creative Thought

Creative thought involves solving problems in a unique manner that is not predetermined by the situation or task (Kay, 1994). In order to solve a problem, the problem must be correctly defined (Dudek & Cote, 1994; Guilford, 1983; Paul, 1993; Van Gundy, 1987). This requires individuals to test their perceptions and thus assumptions about certain problems (Runco & Chand, 1994). Part of problem solving involves creating or generating and evaluating a solution (Csikzentmihayli, 1996; Mumford, Baughman & Wayne, 1993; Patrick, 1937; Van Gundy, 1987)

According to Bastick (1982) and Tieszen (2000), the intuitive process is dependant upon the interaction of emotional states and cognitive processes. Authors such as Bastick (1982), Guilford (1983), and Mumford (2001) put forward that an intuitive or analytic approach to problem solving is a stable cognitive style. Corresponding to this thought is that the analytic mode of thought is based on relationships between two elements at a time (Bastick,

1982). That is, individual's associate elements (things/concepts) together and this association forms a relationship (Mumford, Baughman, Supinski & Maher, 1996).

Bastick (1982) submits that underlying intuitive thought is an emotional set that is associated with all the elements in the field of knowledge. Intuitive thought elements are related by their associated feelings, which are complementary and similar to the overall emotional state (Bastick, 1982). Each element contributes to this state. As the emotional state drifts and changes, new elements associated with the new states and sets are contrasted with old elements (Avridson, 1997; Bastick, 1982). Due to the agreeable and similar feelings associated with the elements that have been associated by the individual a unique experience of original juxtapositions of elements can result that is in new combinations of ideas or concepts (Bastick, 1982). These juxtapositions of concepts and facts thus result in new and original analogies (Mumford, 2001). The new elements are related by a common subjective feeling not by logic (McMullen, 2003; Root-Bernstein, 2002).

In contrast analytical thought is seen as aided thought (Brunswick, 1966 as cited in Bastick, 1982). It is in this mode of thought that a person consciously imposes transformations on information. This author submits that thinking in the analytical mode is slow and uses a limited range of information, has a high degree of awareness and when incorrect, produces large errors (Brunswick, 1966 as cited in Bastick, 1982).

Bastick (1982) and Root- Bernstein (2002) propose that intuition is the first stage of creativity. When intuition is applied in scientific and mathematical fields it is followed by logical verification of the intuition (Miller, 1997). Consequently the individual needs to be able to communicate in the jargon of the field that is maths or science (Bastick, 1982). This may be difficult as intuition is preverbal and contained within the body (Bastick, 1982; Koontz, 2001; Robinson, 2001)

1.9 AIMS

The aims of this research are to establish whether the irrational functions of intuition and sensation as conceptualised by Jung (1923a) are related to creative thought or problem solving and how this impacts on the performance of engineering students enrolled for the course *Introduction to Innovation*.

CHAPTER TWO

LITERATURE REVIEW

2.1.INTRODUCTION

In this chapter I will discuss creative thought and intuition. The chapter will deal with creative thought as a cognitive process and an unconscious process. Creative thought as a cognitive process will explore various facets of creative thought such as defining the problem, processing information, re-organising information, and evaluation and implementation of the solution. Factors that influence creative thought will also be discussed. Thereafter I will discuss creative thought as an unconscious process as conceptualised by various authors such as Blanshard (1964), Cannon (1945), Kris (1952), and Jung (1923). A short section of the role of creative thought in science is included in order to establish whether there is a link between creative thought and science. A brief critique of creative thought will also be included.

Intuition is often indirectly linked to creative thought. It is a somewhat nebulous concept as it has its foundations in the unconscious (Jung, 1923) .It is thus difficult to define and investigate this factor. This factor will thus be discussed separately from creative thought, although there is some overlap.

The section on intuition will investigate intuition from a cognitive viewpoint and will include brief discussions of intuition as a behavioural process as well as the neurological link to intuition. Thereafter intuition will be dealt with as an unconscious process. A brief section of the role of intuition in science will also be included in order to draw the link between intuition and science. Thereafter a brief criticism of intuition will follow.

The distinction between creative thought and intuition is artificial and is made in order to facilitate understanding of these concepts.

2.2 CREATIVE THOUGHT

A great deal has been written about creativity, creative thought and problem solving (Houtz, 1994; Li, 1996 Mumford, 2001; Paul, 1993). An investigation of what creative thought is often results in questions of philosophy and metaphysics. That is, it raises questions about the creation of the world, free will versus determinism, and the nature of experience, none of which can be answered with any satisfaction (Rothenberg & Hausman, 1976).

Despite this statement, investigating the nature of creative thought and the creative act is important, as it is relevant to different types of disciplines (Rothenberg & Hausman, 1976). This type of investigation allows new methods of problem solving to arise which has the effect of changing the way problems are regarded in different fields and in turn may even effect the way students are taught to think (Bull, Baloché & Montgomery, 1993; Paul, 1993).

Bull et al. (1993) state that the individual's worldview influences how questions about creative thought are approached. Accordingly it is important to briefly discuss some of the philosophers that have influenced thinking on this subject. Philosophers from Plato to Kant have had differing views on creativity (Rothenberg & Hausman, 1976). These views affect the investigation of this aspect of human endeavour. According to Plato the source of creativity is independent of natural and human resources and creativity is thus seen as originating from the divine (Plato, 1961). Aristotle viewed the creative processes as stemming from natural and human resources. He believed that the creative process was explicable and developed from antecedent conditions (Rothenberg, 1978). Kant believed that creativity was only possible through the creator's consciousness (Rothenberg & Hausman, 1976).

Rothenberg and Hausman (1976) argue that creativity is both determined and undetermined at the same time.

2.2.1 Creative Thought as a Cognitive Process

The literature on creative thought indicates that there are two main approaches to creative thought; it is either unconscious or cognitive and therefore conscious.

This section will deal with creative thought as a cognitive process. The discussion is broken down into various stages of creative thought. However this is an artificial separation of the stages in order to foster understanding of the process. The stages are fluid in that the individual may begin with defining a problem, and after considering the information available, redefine the problem thus the process is not necessarily sequential. That is, the flow between problem identification and arriving at the solution to the problem may be interchangeable.

The stages that will be discussed are, defining the problem, sorting through the information,, and forming new associations or relations between facts and implementation and evaluation of the problem.

2.2.1.1 Problem Finding

In order to begin problem solving the question or problem must be formulated (Paul, 1993). Formulation of a problem originated in the field of science (Dudek & Cote, 1994). Einstein and Infeld (1933) are repeatedly quoted as saying that the formulation of a problem is often more essential than its solution. Defining or formulating a problem is considered to be part of the traditional stage of preparation (Patrick, 1937).

Authors such as Getzels and Csikszentmihayli (1976) saw the first step of creative activity as the discovery or formulation of the problem. Guilford (1983) suggested that creative activity needed both convergent and divergent thinking; that is sensitivity to problems, evaluation of problems, the ability to be original, and flexible in thought and strategy.

Runco and Chand (1994) link problem construction or definition to the creation of a solution. These authors suggest that one of the essential steps

of creative thought is the definition of the problem and the tasks surrounding the problem.

This was reflected in Patrick's (1937) early research that focused on verifying the stages of creative thought identified by Wallas in 1926 that involved; preparation, incubation, inspiration, and verification. The preparation phase involved formulating or identifying the problem. Patrick (1937) indicated that lots of thought changes were monitored during the preparation stage. Dudek and Cote (1994) suggest that the greatest amount of mental activity is spent in the preparation phase. This seems to lend support to the suggestions that problem finding or definition is an essential stage to problem solving or creative thought.

According to Runco and Chand (1994) problem finding consists of a range of behaviours, that is, problem identification and problem definition, as well as a perception that the task is manageable

Kay (1994) posits that problem finding involves the definition of a problem prior to taking actions to solve the problem. Accordingly, Kay (1994) suggests that it is imperative that the problem be well defined as opposed to vague and ill defined. Kay (1994) suggests that whether many ideas or a single solution is sought the thought processes involved in creative thought are directed toward the resolution of the problem. Consequently the way in which the problem is defined, directs the person's search for the solution within certain parameters.

Problem finding is also influenced by the individual's perception of a problem. This is a subjective perception and this impacts on the person's response to stimulus (Kay, 1994). Along with this subjective perception are the individual's personality traits such as motivation, search strategies, and solution strategies which influence problem solving.

According to Patrick (1937), in her observations of the creative process, the association of ideas led to the development of a theme and the process of

creative thought was characterised by emotional remarks and personal preferences.

Dudek and Cote (1994) suggest that problem finding and solving activity is not a purely cognitive search for originality but an expression or a manifestation of emotional involvement with the task. Getzels and Csikzentmihayli (1976) indicated that more original and creative students were involved with human concerns that are actively questioning their purpose in life and thus making the problem-finding task more personal. By giving meaning to their task, the task was invested with more energy and as a result more original and creative ideas were produced (Dudek & Cote, 1994).

Defining the problem involves many facets. This stage is characterised by the response to the information as well as the subjective criteria of motivation and the perception that the task is possible (Kay, 1994). Defining the question or problem is also dependant on the individual's flexibility, that is the ability to consider information from a particular perspective and then alter perspective as the need arises in order to allow acceptance of new information, which is possibly inconsistent with existing information, which may in turn lead to another formulation of the original problem (Guilford, 1983). Therefore defining the problem is both objective and subjective. That is it is objective for the external stimulus or information is presented and the individual attempts to solve the problem and in order to do so must first define the problem. It is subjective for the individual reacts emotionally to the information and on this basis evaluates information, which in turn influences the scope of the problem and the information that is considered when attempting to find a solution.

Consequently the preparatory phase or problem finding phase may be analogous to the surveying of new terrain that occurs in both humans and animals when a new situation is encountered (Dudek & Cote, 1994). As stated above this involves a subjective perception of the tasks or stimulus as well as the emotional valence that accompanies it. Dudek and Cote (1994) suggest that it is an attempt to become familiar with the task or to come to terms with

the stimuli or raw material. It is the cautious delineating of a framework within which to solve the problem (Dudek & Cote, 1994).

2.2.1.2 Information Processing

This stage involves sorting through the information presented and searching for information (Mumford, 2001). Sorting through information allows individuals to make associations and form links with related information or unrelated areas, this in turn assists in the development of new information or new relations between existing facts (Bohm, 1998).

Various investigations were conducted in order to ascertain the factors that assisted in creative thought. Guilford (1950) in his seminal article investigated the factors that were important to creative thought. According to Guilford (1950) divergent thinking was defined as the generation of information from existing information resulting in unique or accepted best outcomes. Kettner, and Guilford and Christensen (1959) proposed that individuals using creative thought are concerned with concepts and categories. According to Kettner et al. (1959) these individuals also investigate and manipulate the relationships between concepts. Mumford (2001) suggests that this manipulative element in creative thought suggests that people eliminate, select and add relations and consequently generate new combinations.

According to Mumford et al. (1996), during an experiment that investigated the effects of information encoding it was discovered that individuals who spent more time on factual information and took into account inconsistent information and ignored irrelevant information produced more original problem solutions.

Quin and Simon (1990) propose that creative achievement in the sciences may be related to the use of methodical and more extensive search strategies during information encoding. Information encoding means sorting through the information and deciding which concepts and categories to use in defining and generating problem solutions (Mumford et al; 1996).

According to Dunbar (1995), the tendency to focus on discrepant information, which is inconsistent with initial expectations, was related to creative achievement in microbiology laboratories. These findings are consistent with idea that a broader search produces a wider range of information (Mumford et al., 1996). Consequently the subsequent combination and reorganisation efforts may make an important contribution to creative thought (Finke, Ward & Smith, 1992; Mumford & Gustafson, 1988; Perkins 1992).

Mumford et al. (1996) propose that convergent search strategies might also influence problem solving. According to these authors the tendency to seek information that is linked to relevant and related principles might contribute to performance (Mumford et al., 1996). Perkins (1995) proposes that the tendency to search for cues that would guide the information search might also contribute to creative thought. The imposition of constraints such as goals and restrictions act as cues and influence the information search; heeding these cues may impact on the performance of creative problem solving (Isaak & Just, 1995).

The information that people search for influences the quality and originality of the solutions that they produce when working on a set of novel, ill defined problems (Mumford et al., 1996). Mumford et al. (1996) propose that creative people focus on relevant information and are capable of selecting various types of information. Kuhn (1970) puts forward the notion that inconsistent facts are also evaluated and she suggests that this provides the basis for novel solutions. Baughman and Mumford (1995) posit that these inconsistencies encourage people to use alternative concepts and lead to new and original reorganisations of concepts and thus new ideas.

2.2.1.3 Category Selection Combination and Re-organisation

If processing information is important in reaching an effective solution the building blocks of information processing are the formation of concepts and categories (Mumford & Gustafson, 1988). These assist in organising and

synthesizing information, which often results in the production of original ideas (Sternberg & Lubart, 1991).

Consequently it is clear that concepts play an important role in creative thought (Mumford, Supinski, Threlfall & Baughman, 1997). These authors suggest that individuals need to make sense of information. Categorising information assists in this process (Mumford et al, 1997).

Fleishman and Mumford (1988) conceive of knowledge as not merely an accumulation of facts, but rather, as a categorical organisation of facts and principles. This together with experience, allows people to make sense of discrete bits of information by placing this information in a broader context (Mumford et al, 1997). These authors suggest that the term concept consists of organised structures or sets of information that forms categories and schemas (Mumford et al., 1997).

Consequently individuals with a larger knowledge base have a larger number of categories, and therefore, more concepts available as a result. Information can be organised on the basis of underlying principles. This facilitates the acquisition of information and applying it to problem solving (Chi, Bassok, Lewis, Reimann & Glaser, 1989). Individuals in this position are usually experts and are thus more adept than novices at generating problem solutions (Chi et al., 1989). According to Chi and Glaser and Farr (1987) experts use concepts based on underlying principles. Mumford et al. (1997), argue that if information is selected and sorted on the basis of principle constructs, that this might contribute to creative thought in that these principles may provide links between different pieces of information from different domains. This, they argue, is necessary for a successful combination and reorganisation of information, which may provide novel ideas.

Categories are composed of sets of examples; these are sorted by typicality, they imply certain features (e.g. birds fly). Bejar, Chaffin and Embertson (1991) suggest that these sets of categories and the mental models used to

structure relations between categories provide the foundation used in problem solving.

Mumford et al. (1997) submit that categories or concepts aid creative problem solving as they help us acquire, organise and retain information about relevant events during the information encoding process. These authors suggest that categories chosen for the observed event provide the basic raw material used in people's combination and reorganisation efforts thus influencing the generation of new ideas (Mumford et al., 1997). This suggests that the kind of categories selected by an individual will also influence the nature and success of their creative problem solving efforts (Mumford et al., 1997).

Sternberg and Lubart (1991) propose that the combination and reorganisation process plays an important role in the production of new ideas. In combination and reorganisation, people combine and reorganise existing knowledge structures or conceptual categories (Mumford, Baughman, Maher, Costanza & Supinski, 1997). These new linkages can provide new ways of understanding a problem situation, providing a basis for new ideas (Mumford et al., 1997).

According to Chi, Glaser and Rees (1982) the more expertise the individual possesses the more he/she is able to identify, sort, and understand information. Mumford, et al. (1996) suggest that principle-based knowledge structures which develop with experience appear to contribute to the more rapid and accurate encoding of relevant information. That is, information is organised in terms of categories and concepts and the more expertise an individual has the more likely that he/she is able to use concepts to organise a great deal of information (Mumford et al., 1996).

The ability to organise large amounts of information leads to abstract concepts and thoughts (Miller, 1997). The use of abstract concepts facilitates the production of new ideas (Tieszen, 2000).

2.2.1.4 Evaluation, Solution Implementation and Monitoring

The final stage in problem solving involves evaluation and implementation. Whilst the individual may arrive at a solution prior to implementation, the solution is measured against criteria such as practicality, originality, and aesthetics. This is a process that is both subjective and objective. It is subjective for aesthetics are often personal and in part dictated by popular fashion. The criterion of usefulness is also important as it relates in a pragmatic way to the implementation of the solution, and usefulness is often dependant on whether the solution is cost effective. Consequently both external and subjective factors influence the discovery of a solution.

As early as 1926 Wallas conceived of four stages of creative thought, which are similar to the stages mentioned above (Rothenberg & Hausman, 1976). One of the stages that Wallas mentions is verification or evaluation. Patrick (1937) confirmed that this stage was a refinement of the problem finding stage that is illumination as conceived by Wallas. According to Wilson, Guilford, Christensen and Lewis (1954) this involves the ability to identify the consequences of a new idea or strategy. They named this ability conceptual foresight. It is suggested that evaluation of ideas plays an important role in creative thought (Mumford, Baughman & Wayne, 1993; Mumford, 2001).

An ability that goes hand in hand with conceptual foresight is the ability to perceive the implications of implicit changes in the meaning of information or events in the environment that they find themselves in (Mumford, 2001).

Research by Davidson and Sternberg (1984) indicate that creative people are able to identify core facts and irregular information. This process is then used to evaluate and adapt the idea, and may lead to the generation of new ideas. Mumford (2001) proposes that this concept of redefining an idea or concept relies on looking at the global picture and involves improvisation.

Runco and Chand (1994) suggest that both intrapersonal and interpersonal evaluations effect the ideas produced. According to these authors, ideas are

thus evaluated on the basis of how they will be received and whether they are original. Another factor that influences the evaluative process is aesthetics and utility. That is whether the solution useful and aesthetically pleasing in the environment that the person finds himself/herself in, otherwise although the idea may be original it cannot be put into practice and it will be evaluated as inappropriate (Runco & Chand, 1994). Consequently creative ideas must be appropriate and fitting as well as original.

Individuals have difficulty assessing the quality of their own work due to the psychological investment in the idea, and a critic may be able to provide a more accurate reflection of the originality and creativity of a product (Runco & Chand, 1994). Ideas are first evaluated by the creator himself/herself and then by the public. Consequently, interpersonal evaluation includes what others think about the idea as well as the individual's subjective judgement about the idea and the context that the person finds himself/herself in (Gilhooly, 1982). This situation may inhibit the production of ideas. According to Runco and Chand (1994), socialisation, which occurs at an early age, also influences the evaluation of ideas; and thus an increased conventionality of thought due to social feedback.

Runco and Chand (1994) suggest that creative thought is a social activity and does not rely on any one individual, and it occurs in a context, thus, interpersonal evaluation effects the production of original and creative ideas. Csikszentmihalyi (1996) suggests that all creators have an audience and as such creative thought occurs in a context.

These authors suggest that the evaluation process consists of evaluation based on intrapersonal and interpersonal skills as well as the ability to produce a number of ideas and determine whether these are aesthetic and useful (Runco & Chand, 1994, Gilhooly, 1982,). Another dimension to evaluation is the ability to distinguish between judgements about ideas and meta-cognitive evaluations, which involve evaluations about ideas and potential solutions rather than process or progress (Miller, 1997; Runco & Chand, 1994; Tiezsen, 2000).

Mumford, Baughman and Wayne (1993) suggest that the implementation of the idea is an important step, as the context that the individual finds himself/herself in often determines the translation of the idea into action. According to the above authors, idea implementation requires solution monitoring and taking account of negative feedback, which can be used in subsequent problem solving efforts.

2.3. FACTORS INFLUENCING CREATIVE THOUGHT

The above discussion focused on the stages of creative thought. The following discussion will focus on factors or strategies that influence the process of creative thought. These factors assist in the production of novel and unique outcomes, which are used as indicia of creative thought.

2.3.1. Fluency, Flexibility and Originality

Guilford (1950) identified certain factors that enhanced the ability to produce original and unique outcomes; these are fluency, adaptive flexibility, originality and elaboration. Guilford (1950) saw these factors as cognitive capacities that occur in different types of problem solving tasks.

Fluency was important to Guilford (1950) as it concerned the speed at which ideas were generated. Guilford (1950) believed that the greater number of ideas produced in a specific period of time would be advantageous in creative efforts. Research by Jensen (1981) also indicates that the speed at which ideas are produced is an important factor in cognitive functioning. Mumford (2001) suggests that this is an important factor and may be connected to the manner in which links are made between differing facts and the re-organisation of these facts into new relationships. Simonton (1998) proposes that the speed at which ideas are generated could provide a larger pool of ideas to work with, and as such, leading to the production of more original ideas and products.

Other studies by Getzels and Csikszentmihalyi (1976) and Redmond, Mumford and Teach (1993) discovered that the more time that was spent on defining the problem, contributed exponentially to the production of more useful ideas.

Guilford (1950) regarded flexibility as a key factor in contributing to creative problem solving. Guilford (1950) understood this as the ability to change strategy or approach. Wilson et al. (1954) found that flexibility involved the ability to adapt the approach or strategy to the demands of the context wherein the problem was situated.

This is borne out in research by Quin and Simon (1990) that indicates that individuals with specific expertise have a broader range of heuristics and strategies available as compared to novices in the field. According to Mumford (2001) the use of heuristics has been linked to creative achievement in the sciences and creative problem solving. Mumford (2001) suggests that further research is needed in this area of flexibility, as little is known as to how people know when to shift strategies or identify appropriate strategies.

Guilford (1950) conceived originality as unconventional lines of thought on problems where there was no correct answer. Mumford (2001) suggests that this is linked to divergent thinking. That is, originality is conceived of as generating new, usable products from existing facts or information (Simonton, 1990). Consequently Mumford, Baughman and Wayne (1993) propose that originality is derived from employing differing strategies and heuristics to produce novel ideas within existing parameters. It is further suggested that the method of acquiring information and reorganising information into new concepts also plays a role in creative thought (Baughman & Mumford, 1995).

According to the cognitive model, creative thought has numerous stages and these contribute to the production of novel ideas. The model discussed thus far indicates that problem finding, information processing, category selection, category combination and re-organisation; and idea evaluation, solution

implementation, and monitoring are processes that are involved in creative thought (Mumford et al., 1997).

Creative thought for the above mentioned authors involves the above processes and can possibly be defined as the production of a novel idea that originates through the re-organisation of ideas from different fields of information, as well as the usefulness of the product or idea that is situated within a context (Mumford, et al., 1997).

2.4 CREATIVE THOUGHT AS AN UNCONSCIOUS PROCESS

Writers such as Cannon (1945), Blanshard (1964), Freud (1908), Jung (1923b), Kris (1952), conceive of the creative process as occurring outside consciousness, that is, as an unconscious process (in Rothenberg & Hausman, 1976).

Cannon (1945) suggested that the unconscious provides the main thrust for providing solutions. Blanshard (1964) proposed that the creative process developed in terms of a specialised order, which operates at a non-conscious and conscious level. That is, the individual creates, as result of an inner necessity, within a system. Koestler (1964) suggested that the creative process involves several levels of consciousness as well as the subconscious. According to Koestler (1964), the creative act involves the linking together of two previously unconnected frames of reference. Johnson (1971) suggests that creative thought arises by discovering new links in previously unrelated fields and the ability to select and weave these elements into a new whole.

Kris (1952) suggested that regression in the service of the ego partly explains the creative act. Kris (1952) based his theory on Freud's conceptualisation of the ego, id and superego and the fact that the ego produced two kinds of energy, neutralised energy and libidinal energy. Houtz (1994) explains that this means that the conflict between the id and the superego represents the

struggle between pure gratification and pure authority. The ego mediates between the id and superego and compromises (Houtz, 1994).

According to Kris (1952) fantasy releases more libidinal energy. Kris (1952) postulated that in fantasy the processes of the ego are largely in the service of the id, which is to say regressed. Thus, to be creative requires indulging in fantasy (Houtz, 1994). According to Houtz (1994) a strong ego can do this that is, indulging in fantasy, in order to identify new and different ideas or combinations of ideas. According to Kris (1952), ego regression occurs in fantasy and during the creative process, but in the creative processes the ego is not overwhelmed by the regression, it is used to elaborate on an unconscious thought or idea. According to Kris (1952), when energy is diverted to fantasy and thus away from the perceiving function of the ego, this may intensify the preconscious process and provide for the clarification or 'aha' experience that an individual may experience when a solution to a problem appears after a period of rest.

Rothenberg and Hausman (1976) suggest that psychoanalytic theory makes the distinction between primary and secondary processes of thought. These authors suggest that the inventive phase belongs to the primary process and the stages of elaboration and verification to the secondary process (Rothenberg & Hausman, 1976). It is suggested that primary process thought is non logical and draws on mechanisms found in dreaming, such as symbolization, condensation and displacement, and the secondary process is logical and rational and under voluntary control (Rothenberg & Hausman, 1976). Thus creative thought is seen as being derived from both a cognitive and unconscious process.

According to Jung (1923b) the creative act defies explanation. Despite this statement Jung (1923b) explained that the creative complex is an autonomous complex. It is a psychic formation that occurs unconsciously and when it comes to consciousness, it can be perceived and sensed but it is not possible to bring this complex under conscious control, thus it comes and goes as it pleases (Jung, 1923b). Jung (1923b) explained that the

autonomous creative complex was established when an unconscious part of the psyche was activated. It is at this stage that energy is withdrawn from the conscious (Jung 1923b). This withdrawal of energy results in the individual withdrawing from conscious interests and activities and it is out of this withdrawal that the autonomous creative complex is developed (Jung, 1923b). Jung (1923b) suggests that as a result the instinctive takes over and this he links to the collective unconscious.

Jung (1923b) then suggested that the Collective Unconscious provides the individual with inherent possibilities of ideas. The Collective Unconscious is, according to Jung (1923a) inherited in the structure of the brain. It provides archetypes that are derived from the psychic residue of countless experiences of the same type (Jung, 1923b). Jung (1923b) suggests that the personal unconscious provides the individual with an archetypal idea that is translated into a symbol or image. The adaptation of this archetypal image accompanies a release of emotional energy that surpasses the individual, that is it taps into energy that is beyond the individual and with which all people can identify (Jung, 1923b). Jung (1923b) went on to elaborate that the creative act transcended the personal.

2.5 CREATIVE THOUGHT IN SCIENCE

This section will explore the role of creative thought in science. There are many anecdotes of scientists joining two previously unconnected frames of reference thus arriving at novel ideas and solutions (Gilhooly, 1982; Miller, 1997). This section will deal with recent approaches to creative thought in science, which appears to conceive of creative thought as both conscious and unconscious process as well as an event that is located in a context and influenced by that context (Heisenberg, 1958; Mindell, 2000).

In recent years with the advent of quantum mechanics, the role of creative thought in science has gained more acceptance (Mindell, 2000). Bohm (1998) and Mindell (2000) suggest that scientists in particular search for a wholeness or totality in understanding the structure of the universe.

According to Bohm (1998) this search for harmony and wholeness is driven by the perception of similarities and differences in the world. He suggested that an appreciation for difference and similarity indicates varying degrees of creativity or mechanicalness. These similarities and differences are based on concepts and experiences (Bohm, 1998; Tieszen, 2000). Tieszen (2000) suggests that these concepts are based on constructs, which are forms of consciousness or experiences. Consequently he argues that science or mathematical logic is determined by philosophical constructs that may limit investigation.

Bohm (1998), Tieszen (2000) and Mumford (2001) suggest that all experience could be structured through the use of concepts. Bohm (1998) maintains that an understanding of similarity and difference enables the individual to perceive new orders of structure, both in the objective world of nature and in the mind itself. This perception of new structures leads to creative thought (Bohm, 1998, Mindell, 1989).

Reference is made to two quantum principles found in quantum physics that the observer and the observed are intimately connected and that through the act of observation and measurement both are changed (Heisenberg, 1958; Sheldrake, 1995). Consequently, if this is applied to creative thought then creative thought arises from perception and interplay between the observed and the observer (Mindell, 2000).

Bohm (1998) explains that the conflict caused by the perception of a fact that does not fit with the established paradigm leads to self-imposed confusion, that is, a confusion designed to avoid perceiving this fact. He suggests that in order to promote creativity that some part of confusion be maintained. Another way of saying this is to let the individual's attention become less focused, diffuse, and as a result allowing contradictory facts and relationships into consciousness (Gelernter, 1994).

Bohm's concept of searching for wholeness ties into creative thought in that he conceived of creative thought as the development of new paradigms which evolve from a stream of consciousness and unconscious thought (Mindell, 2000). Moreover as Bohm refers to a search for wholeness he suggests that creative thought is dependent on the context and the larger system or whole (Csikzentmihalyi, 1988; Mindell, 2000). This bears striking similarity to Jung's idea that the Collective Unconscious provides the individual with an idea that is then translated into a symbol or image.

Mumford (1998) suggests that creative thought based on the unconscious process relies on associational links. That is the production of a creative thought arises from associations and representations that are experientially based as well as a period of incubation (Gilhooly, 1982; Mumford, 1998). According to Mumford (1998) this then includes the emotional component of creative thought and could possibly be linked to intuition.

Creative thought as an unconscious process is based on diverse ideas such as regression in the service of the ego (Kris, 1952), the collective unconscious (Jung, 1923b), an autonomous creative complex (Jung, 1923b) and associations that are experientially made which includes an emotional element (Mumford, 1998).

It is also based on the suggestion made by Bohm (1998) and Mindell (2000) that creative thought occurs in a dream state or altered state of consciousness where the boundary between the observer, the observed and the system that the individual is located in is fused.

2.6 CRITICISM OF CREATIVE THOUGHT

This section will discuss some of the criticism levelled at attempting to define and explain a concept such as creative thought.

Authors such as Mumford et al., (1996), Runco (1994), Dudek and Cote (1994), and Wilson et al. (1954) hold that creative thought is a cognitive

process and consists of various stages, as elaborated in the above discussion. Part of these stages is divergent and convergent thought (Wilson et al., 1954, Mumford, 2001) Eysenck (1993) suggests that divergent and convergent thinking is different modes of thought. He suggests that the new or novel product is only new in the sense that it is created by the terms of the problem. In essence there is no truly unique outcome rather a solution is implied by the problem.

Eysenck (1993) states that while these types of thinking are useful he does not link creativity to intelligence. He suggests that cognitive style may be a feature of personality.

Although it appears that there are various phases to creative thought such, as problem defining and finding, that are accepted (Kay, 1994), stages that appear to be part of creative thought in the unconscious process, such as the 'aha' experience or the period of incubation that precedes this experience appear to be controversial. It has been suggested that creative thought is a long process involving gradual solutions (Hayes, 1978; Miller, 1997). The 'aha' or eureka experience does occur but it is suggested that this is not part of every creative act (Hayes, 1978).

Hayes (1978) suggests that the creative act or solution is dependant on the observer. He suggests that it is difficult for an observer to determine whether the solution is truly creative. For instance the observer may not have the same broad range of knowledge used to resolve a problem and may therefore not be able to draw links and associations between certain fields (Gilhooly, 1982; Hayes, 1978; Runco & Chand, 1994) Determining whether a product is creative or not also depends on the social context and the acceptability of the idea or product in society (Boden, 1998). Thus determining what is creative is based on the viewer's subjective perspective, which is subject to social sanction.

The role of aesthetics and creative thought and science has been briefly discussed in terms of the search for harmony and wholeness (Bohm, 1998).

Eysenck (1993) cautions against this approach as it is unreliable and has led many a scientist to falsify or fudge results in favour of an elegant result.

Currently the processes involved in creative thought are still under investigation (Mumford, 2001). It appears that consensus has been reached on certain phases such as problem definition that is part of the initial stage of preparation. It is also apparent that there is consensus on the cognitive process of forming associational links that produce new perspectives as well as evaluation and implementation (Bastick, 1982; Eysenck, 1993; Mumford et al., 1997; Runco & Chand1994). What appears to be unclear and will probably remain so is the unconscious process that is involved in creative thought.

2.7 SUMMARY

Creative thought thus comprises of two levels of processes that are intertwined, conscious and unconscious processes. On the conscious level a problem is identified and defined (Kay, 1994; Runco & Chand, 1994). The individual's perception and experience of the problem and the context wherein the individual exists also effects the generation of a solution (Dudek & Cote, 1994; Getzels & Czikentmihayli, 1976; Gilhooly, 1982; Kay, 1994;). Thereafter the individual's level of expertise and area of knowledge are related to the manner in which the information is categorised and conceptualised (Mumford, 2001). It is the interplay between the different areas of knowledge and experience that produce original combinations and eventually new knowledge (Mumford et al., 1996). A solution is implemented based on the ability to foresee the consequences of the new ideas, as well as the social perception and evaluation of the new idea (Gilhooly, 1982; Mumford, 2001).

Creative thought, it has been suggested, is an unconscious process, which is unknown and generates original solutions. Koestler (1964) suggests that creative thought arises due to inner necessity. Kris (1952) links creative thought to dreaming and fantasy, which allows the elaboration of an unconscious thought. Rothenberg and Hausman (1976) suggest that although the first phase in creative thought may be dreaming and fantasy the second

stage is logical and rational and thus conscious. There is thus a suggestion that creative thought consists and arises from associational links and an incubation period.

Bohm (1998) and Mindell (2000) suggest that creative thought arises from both a conscious and unconscious state. That is, in order to convey the original thought or idea, reference is made to concepts and facts that are widely accepted and understood. Mindell (2000) terms this 'Consensus Reality'. The new thought or idea, it is suggested, is generated when the individual allows herself to be drawn into a 'dreaming' state that is subjective, and taps into the collective unconscious. Mindell (2000) terms this state 'Non-Consensus- Reality' as it is based on subjective experience. He suggests that it is through 'Non-Consensus-Reality' that new concepts develop. These new concepts are then symbolised in 'Consensus Reality' terms making them conscious (Mindell, 2000).

2.8. INTUITION AS A CONSCIOUS PROCESS

This section will deal with intuition as a cognitive process by virtue of the observable behaviours. Thereafter the discussion will focus on intuition as an unconscious process.

A short discussion will also be presented about the role of and influence of intuition in science. Thereafter a brief discussion about how aesthetics influences science will follow.

A short critique on relying on and using intuition will also be presented.

2.8.1 Introduction

There is a plethora of writing on intuition and identifying the processes and behaviour involved (Bunge, 1962; Hall, 2002; Linzey, 2001; Ruth-Sahd, 2003; Wilson, 1998). A broad overview of the main views of intuition will be presented. Intuition, it is argued, is unconscious and thus it is impossible to

measure it (Westcott, 1968). However, the behaviours surrounding intuition are observable and able to be quantified and thus measured (Westcott, 1968). Thus intuition is conceived of as a behaviour that is conscious but arises from an unconscious process. Intuition has been conceptualised from an unconscious perspective (Jung, 1969, von Franz, 1992.) It has also been investigated from a phenomenological perspective and discussed from a metaphysical perspective (Burneko, 1997; Williams & Irving, 1996).

Cognitive and affective elements that lead up to intuition have been investigated, as well as the internal processes of emotional frameworks and the external processes of the social environment that support intuition have been explored (Arvidson, 1997; Gick & Lockhart, 1995).

The debate between intuition and knowledge began with Kant who held that there were intrinsic categories of mind, which made possible categories of perceptual judgement (Westcott, 1968). He also suggested that it was possible to know truth based on general principles (Westcott, 1968). Helmholtz disagreed with this view and proposed that there were no inherent categories and that the Truth could not be known through the use of general principles (Rothenberg & Hausman, 1976).

This debate arose again between the Gestalt and Associationist psychology schools (Bastick, 1982). From a Gestalt perspective the world is a totality, which can be analysed, and those who found this experience to be built from separate sensory events (Kohler, 1929; Mayer, 1995; Wertheimer, 1945; Thorndike, 1898). This debate can be reduced to two arguments, that reality is a given and that it is a construction (Westcott, 1968).

The above approaches will be briefly discussed. It is important to note that each of the above approaches derives from different philosophical roots and these determine how intuition is conceptualised and defined and studied.

2.8.2 Intuition as Behaviour

Intuition as behaviour is seen as intuition- as- inference (Westcott, 1968). Over and above steps, which are obscure, and the feeling of certainty, the emotional arousal, as well as the suddenness of knowing, the intuitive event is defined as a cognitive result (Davidson, 1995). The result is a product, which can be verified, and its accuracy tested (Westcott, 1968).

Intuition as behaviour can be conceptualised as inference behaviour, which is based on indistinct sensory data that is rapidly combined and inexplicitly leading to the correct conclusion (Westcott, 1968). The individual who engages in this behaviour is unable to specify how these conclusions are reached (Westcott, 1968).

Research in this field has thus investigated the way in which data on which the conclusion is based is acquired, the way data is combined, the level of awareness that the individual has when manipulating the sense data, the primitiveness of the functions involved, the differences in accuracy and plausibility of the conclusions reached, the personality characteristics of individuals who have the tendency for this kind of behaviour, the conditions which support this behaviour, and the emotional components of the behaviour (Dominowski & Dallob, 1995; Mayer, 1992).

From this perspective intuition- as- inference, information, data, knowledge, restructuring the problem, environmental context, motivation, and cues are central (Finke et al, 1992). According to Davidson (1995) intuition is based on the manner in which the individual deals with the information at hand. Insight or intuition is a response under conditions of deficiency of either data or operations, that is, the manner in which the individual manipulates and constructs a novel representation of information in order to obtain a solution (Gick & Lockhart, 1995). Intuition may be defined as reaching a conclusion under circumstances where there is insufficient information or data and the

conclusion is subsequently verified under conditions of sufficient data or information (Westcott, 1968).

2.8.3 Intuition as a Cognitive Function

The cognitive theorists use intuition to refer to the classification of a stimulus event (Stent, 1968). That is, when the event occurs it is broken down into constituent parts of experience, categories, and concepts, although these characteristics are not always explicit. According to Dominowski and Dallob (1995) and Davidson (1995) this is a rapid coding of information and development of meaning based on the way the event is categorised. Thus it is an inferential process in which some of the principles are already contained within the event and some are contained within the coding system of the observer (Davidson, 1995). Intuition in this sense is a construction by the individual of the experience (Tieszen, 2000).

Westcott (1968) holds that intuition occurs when a person approaches a problem and solves it without sufficient information. Finke et al.(1992) and Pfenninger and Shubik (2001) state that this process consists of drawing from existing fields of knowledge and experience. By drawing on these fields, experiment with them, and attempt unconscious trial and error behaviour that eventually forms and generates analogies, metaphors and combinations (Davidson, 1995). Mayer (1992) suggests that eventually a match is found among the different combinations and the individual recognises when this occurs. Intuition it is suggested is thus inference.

Another author Wilson (1998) suggests that intuition acts as a bridge between cognition and the ability to express thoughts through metaphors or symbols. That is, he suggests that it acts as a bridge between instinct and cognition (Wilson, 1998). Wilson (1998) thus proposes that intuition is more than inference.

Instinct, he suggests, is inflexible and rigid, and cognition is fluid and flexible (Wilson, 1998). Instinct is dependant on concrete experience in the world,

whereas, cognition allows for abstraction and uses metaphor to identify and give meaning to experience (Wilson, 1998). He suggests that intuition operates between these two ways of knowing. That is, it enables an escape from rigid instinct by combining dissimilar experiences and information and combining them into a whole. Intuition is not logical and does not rely on a conditioned response (Wilson, 1998). According to Wilson (1998), intuition as a bridge allows thinking to flow from the instinctive or subconscious to the conscious, and from the conscious back to the instinctive.

2.8.4 Intuition and Attention

Avridson (1997) suggests that our conscious experience is organised in terms of figure and ground, that is, in terms of themes and thematic field, background themes. Avridson (1997) and Gelernter (1994) liken intuition to organisation of information and consciousness and the shifts of attention and reorganisation in consciousness that is required for intuition to manifest.

When using the term consciousness the author proposes that it is all that is present or intended at any moment (Avridson, 1997; Mindell, 2000). He suggests that consciousness is organised along three dimensions; theme, thematic field, and margin. The author is making reference to the quantum theory called the field theory (Avridson, 1997). Briefly this is analogous to a blanket where if one pulls a thread on one side of the blanket another part of the blanket will be affected. Simply put everything is connected to everything else and small changes to one thing affect other systems that are not linearly related (Sheldrake, 1995; Pfenninger & Shubick, 2001).

According to Davidson (1995) the theme is that with which the individual is focusing on in the present. It is presented as a unit that can be broken down into its parts. These parts can then be restructured or the structure of the parts can be understood and this facilitates understanding and eventually insight or intuition. It is also independent from the background context even though the context is related to it (Avridson, 1997; Pfenninger & Shubick, 2001).

The thematic field represents the relevant context or background for the theme. The thematic field's elements are organised in terms of relevance to the theme and relevance to each other (Avridson, 1997). The items or elements that are most relevant are presented perceptually close to the theme but not physically close to the theme, and those that are deemed to be irrelevant are presented as further away (Dominowski & Dallob, 1995).

Pfenninger and Shubick (2001) suggest that in the process of problem solving attention shifts from the theme to the thematic field and back again. This, he suggests is how solutions are generated (Avridson, 1997). That is, the shifting of attention necessitates perceiving the parts of a problem in a context, as a whole and then back again as units (Gick & Lockhart, 1995).

Avridson (1997) and Davidson (1995) submit that there is a process that is followed in terms of how intuition arises.

The first stage is elucidation, that is, where the presented theme remains the same and the thematic-field changes (Avridson, 1997). That is the information is encoded, combined, and a comparison is made between non-obvious relationships (Davidson, 1995). According to Avridson (1997) in the intuition experience the theme undergoes a change and a new theme emerges.

Singling out involves an adaptation of attention, that is, the zooming –in or focusing or selecting and as a result of this, a new theme is presented (Gelernter, 1994) Singling out, Avridson (1997) argues, is not part of the structuring of intuition, it is merely indicative of the alteration of the theme that accounts for the 'Aha' experience. As this theme is new it has a different relationship to its thematic field and a different functional relationship in terms of its own internal structure and the elements that make up the theme (Davidson, 1995).

Synthesis involves a re-organisation of information and consciousness in that, what was originally the focus of attention is now an element of the new theme (Avridson, 1997; Davidson, 1995; Pfenniger & Shubick, 2001).

From a phenomenological viewpoint, intuition is the sudden reorganisation of the field of consciousness (Burneko, 1997). That is, through the adjustment of attention called synthesis, in which the previous theme (idea) is replaced with a new theme (Avridson, 1997). Synthesis is the rapid materialization and fleeting steadying of thematic consciousness. It involves the replacement of one thematic presentation with another and the previous theme is incorporated as an element in the new theme

Avridson (1997) defines intuition as a rapid solution to a problem, the solution appears to be complete and is separate from the processes that led up to it.

2.9. THE NEUROLOGICAL LINK TO INTUITION

This section will briefly discuss the neurological link to intuition, that is, where the function of intuition is situated and the genetic predisposition for using this function as well as the emotional link to intuition.

According to Pitcher (1999), research by Damasio indicates that intuition or the skill in accessing this part of our brain is genetically inherited. According to Thompson (2002), intuition is situated on the right side of the brain. The author suggests that it is this hemisphere that is responsible for a global perspective and perceiving patterns (Thompson, 2002).

Together with the above suggestion that intuition is partly genetic, McMullen (2003) proposes that intuition is part of unconscious intelligence and is an adjunct to rational thought. According to McMullen (2003), research by Damasio indicates that intuition is that which binds together the individual's conscious action and intelligent action. Root-Bernstein (2002) suggests that logical decision-making is linked to emotional affect. According to this author, individuals who have suffered head injuries lose the ability to make rational

decisions despite having an intact rational function (Root-Bernstein, 2002). According to Root-Bernstein (2002), research by Damasio and Cytowic suggest that feeling and intuition are the foundation for rational thought.

It is suggested that intuition is located in the prefrontal lobe in the forebrain and that intuition arises as a subconscious feeling (Wanless, 2002). That is, individuals are borne with this predisposition. Pitcher (1999) argues that emotions precede thought and that as new situations are experienced so new thoughts and emotions arise and new neural pathways are laid down.

Consequently, it is suggested by Pitcher (1999) that thinking has its foundation in emotion and sound judgement, and that rational thought is dependant on emotional signalling. That is, rational thought is dependant on recognising and coding emotions. It is these emotions that ensure that strategy changes and that an individual learns (Pitcher, 1999).

If intuition is found in our neural pathways it is not surprising that intuition has also been linked to physical sensations in the body and emotional reactions as well as synchronistic events (Clarke, 2001; Damasio, 1994; Koontz, 2001; Robinson, 2001). Therefore it appears that intuition has a genetic, unconscious, and partly rational component, all of which function together to provide individuals with intuition.

2.10 INTUITION FROM AN UNCONSCIOUS VIEWPOINT

This section will discuss intuition as an unconscious process. Intuition is derived from the Latin 'intuetor' meaning to look upon or to gaze upon or contemplate (Birgerstam, 2002). This core word indicates that intuition has its basis in perception, which is by necessity sensory and, as such, unconscious. A short discussion of Jung's approach to intuition and a brief discussion of intuition from a phenomenological and metaphysical perspective will follow.

2.10.1 Jung on Intuition

Jung conceived of intuition as arising out of the individuation and development of personality and not a theory of knowledge (Jung, 1923b; Jung, 1950; Jung, 1954; Spoto, 1995; Westcott, 1968). According to Jung (1954), intuition is one of four mental functions that are present in all individuals. These four functions achieve different degrees of dominance during the life of each individual (Spoto, 1995). These four functions in combination with three levels of consciousness and two general orienting attitudes (extraversion and introversion), greatly determine, each person's characteristic behaviour (Jung, 1954).

In brief the four functions are, thinking, feeling, sensing, and intuition (Jung, 1923a). Both thinking and feeling involve judgement and are thus known as rational functions (Spoto, 1995). The judgement in thinking is based on true or false logical deductions, inferences, and cognitions of objective fact (Spoto, 1995). The feeling function involves judgements of pleasant and unpleasant, acceptance and rejection of like and dislike (Maddi, 1996).

Spoto (1995) postulates that, sensing and intuition are irrational and do not involve judgements. According to Jung (1923a), sensation is a function whereby the individual receives information through the modalities of sense, (that is touch, sight, sound, etc.) This perception of sensory details is accepted as objective truth (Westcott, 1968). Intuition is conceived as non-judgemental or irrational (Spoto, 1995). Intuition looks at the possibilities or implications of a theory or idea, it takes a global view of the information at the expense of details (Storr, 1973). This perception of possibilities and principles is taken as truth (Westcott, 1968).

In order to understand how Jung (1954) viewed the use of intuition, an explanation of the three layers of consciousness will be discussed. There are three levels of consciousness, the personal conscious, personal unconscious and the collective unconscious (Jung, 1954). Jung (1954) theorised that, the personal conscious contains everything that the individual is aware of, that is,

objects and processes. The personal unconscious contains processes and objects that are weak and those that have been repressed as unwanted and not functional (Jung, 1954). According to Jung (1969), the Collective Unconscious consists of systems of symbolism and learning. That is, the learnt reaction over millennia related to universal human situations; this includes the individual's entire ancestral lineage, family, ethnic group, nation, and species (Jung, 1954; Jung, 1969). Jung (1954) suggested that, this knowledge and the universal symbol systems are inherited in the brain structure of each individual alongside reflexes and instincts.

Jung (1923a) postulated that, intuition perceives information unconsciously and uncritically, as does sensation. Intuition observes possibilities, principles and the consequences of situations perceived from a holistic view (Jung, 1923a). This perception often lacks details (Westcott, 1968; Monte, 1980; Jung, 1923a). Spoto (1995) asserts that both intuition and sensation accept the perception as an objective given truth.

Berne (1955) proposes that it is through intuition that the possibilities and implications of external objects, situations, and internal states are brought to the fore. Berne (1955) goes further and draws the distinction between the intuitive perception of both the personal unconscious and collective unconscious from the invasion of the conscious by overwhelming undistinguishable primitive unconscious material.

Berne (1962) theorizes that, primal images that derive from infantile object relations may also be the source of intuitions. These, he argues, might or might not be accurate and are usually not accessible to consciousness (Westcott, 1968) According to Berne (1962), these are accessible in pathological states and the ordinary consciousness has blue prints of these primal images.

Spoto (1995) suggests that, intuitions that are derived from the collective unconscious are more important than those that arise from the personal unconscious. This relates to Jung's view on creativity and problem solving in

that as the collective unconscious contains symbols and knowledge accumulated over millennia, intuition arising from this source contains basic wisdom and the intuitive person may be able to translate this into current life (Jung, 1923b).

von Franz (1992) proposes that, Jung's idea of the collective unconscious transcends time and space. It is suggested that this allows a global view of thinking that is not either or but both and.

Westcott (1968) suggests that intuition is a way of knowing that is instantaneous and uncritical but is subject to adaptation. Spoto (1995) posits that knowledge gained by intuition looks at potential possibilities and knowledge gained by sensation looks at details. According to Jung (1923a), intuition is an elevated type of knowledge when the unconscious, both personal and collective, becomes conscious. Intuition can be defined as knowing or grasping something without knowing how this understanding came to be (Westcott, 1968)

Jung (1923a) places the function of perceiving implications, possibilities, and principles similar to the function of perceiving elements and details. That is, the functions of sensing and intuition are similar in that they are irrational and rely on perception (Jung, 1923a). According to Jung (1954), these two functions along with the personal and collective unconscious are linked to internal and external events and provide knowledge through intuition. In terms of this view, intuition is not reducible to inference (Westcott, 1968).

2.10.2 Intuition from a Phenomenological and Metaphysical Viewpoint

This approach views intuition as an experience. It is viewed from a subjective and holistic perspective (Burneko, 1997). According to Burneko (1997) there are several configurations of consciousness, archaic, mythical, and magical, rational, and integral. These structures build upon one another over time (Burneko, 1997).

Burneko (1997) argues that the structure that has been most dominant is the rational mode of consciousness. This, it is suggested, derived from the Cartesian split between the external world filled with objects that are only knowable through the senses and the inner world (Williams & Irving, 1996). Williams and Irving (1996) suggest that knowledge arises as a result of the individual's own experience.

Rational thought has thus dominated consciousness and determines how information is processed (Burneko, 1997). Burneko (1997) proposes that this mode of thought dualises experience and thought in that it categorises experience into areas of subject and object, it also conceives of time as linear. This categorising of experience and thought, he suggests, is a piecemeal approach and has restricted the other modes of thinking (Burneko, 1997).

Various authors propose that in order to be open to intuition the rational mode of thought and consciousness needs to be suspended in order to perceive and observe the possibilities and relationships contained within the current situation (Bohm, 1998; Burneko, 1997; Mindell, 2000).

Burneko (1997) conceives of intuition as the unfolding of the present. That is, it is the non-dualistic presentation of reality, it is 'being-in-the-world' it transcends insight and is subjective (Burneko, 1997; Mindell, 2000). Burneko (1997) proposes that in archetypal terms, it (intuition) perceives psyche and matter as one reality.

Accordingly, the author argues that the split between consciousness and reality is artificial and that it is really one (Burneko, 1997). Burneko (1997) states that meaning, and not substance, constructs reality. In fact, he states that reality has no particular essence or nature but that it is constructed through the development of meaning (Burneko, 1997).

Burneko (1997) argues that intuition as an integral mode of thought has been internalised as wrong and untrustworthy due to the reliance on the rational mode of thought or dualistic way of approaching the world. Burneko (1997)

goes further and argues that when individuals attempt to find meaning for subjective experiences by turning to dualistic philosophy, this negates the reality that the individual and the universe are one. By doing this he argues that individuals reject intuition and the needs it addresses and the place it has in interpersonal and cultural life (Burneko, 1997). By rejecting this mode of being, it is argued that individuals are alienated from themselves and the world (Burneko, 1997). Thus intuition plays a significant part in intrapersonal and interpersonal life (Burneko, 1997).

Burneko (1997) argues that intuition is derived from a metta-pattern. That is, an overarching and background view of events. According to Bateson (1979), the metta-pattern defines the vast generalization, that it is patterns that connect.

According to von Franz (1992), meaning derives from the universal pattern. This pattern is derived from the archetypes that represent all psychic probability (von Franz, 1992). Thus meaning arises from part of a universal pattern that exists and has always existed and partly as countless individual acts of creation (Burneko, 1997).

Burneko (1997) suggests that intuitive meaning arises from organisation and pattern. According to Bateson (1979), pattern is derived from observing differences and difference, he posits, is a phenomenon that is not located in space or time. In this instance intuition is conceived as a subjective experience that is useful in daily life, it connects the individual to the universe and the pattern of life (Mindell, 2000).

2.11 INTUITION IN SCIENCE

According to Bunge (1962) there are various uses of intuition in science. Bunge (1962) conceives of intuition as perception, imagination, reason, and valuation.

Underlying intuition as perception is the swift identification of a thing, event, or sign (Bunge, 1962). In other words, how astute the individual is to sensory information and storing this information, as well as, how well the information is understood and the relationships contained within the event or sign (Bunge, 1962). Bunge (1962) asserts that scientific knowledge transcends perception.

This type of intuition, intuition-as –perception, needs to be communicated and thus interpreted correctly (Bunge, 1962). The communication of intuitive ideas or concepts in science is usually done with the use of symbols and signs. These facilitate intuition as the concept is reduced to an abstract theory (Bunge, 1962). Consequently, Bunge (1962) suggests that intuition is the relationship between the senses and the logic of symbols.

Intuition as imagination is linked to the ability to see in the mind's eye the relations between objects real or imaginary, or the patterns of abstract theories (Bunge, 1962). Physicists such as Wolfgang Pauli suggest that scientific thought begins with the unconscious and concepts emerge in images that possess powerful emotional content (Chandrasekhar, 1987). Intuition as imagination taps into the ability to use metaphors to identify relationships between different theories and different areas of expertise (Bunge, 1962). This is very similar to information coding discussed in creative thought (Mumford, 2001). In fact, Bunge (1962) asserts that inventiveness or inspiration derives from creative imagination. Creative imagination goes beyond sense perception or the ability to use metaphors; it is the ability to create theories that do not match the perception of the senses and provide new alternative ideas (Bunge, 1962). Once this occurs the new idea is then vigorously tested (Bunge, 1962).

Intuition as reason is the ability to reason in a global way, that is, by inferring relationships between objects or theories (Bunge, 1962). This is linked to the ability to produce a unified or harmonious whole out of fragmented items (Bohm, 1998; Bunge, 1962;).

Bunge (1962) suggests that intuition is at times assisted by commonsense and at times it runs counter to commonsense. It is posited that the scientist needs to be aware of this distinction in order to avoid the trap of not investigating an event or developing a theory, as it is contrary to common sense (Bohm, 1998; Bunge, 1962).

The last stage of intuition as science is evaluation of the new concept or theory (Bunge, 1962). According to Bunge (1962) this valuation is based on past experiences and knowledge and as a consequence of these, judgements about a theory are made.

2.12 AESTHETICS AND INTUITION

Root-Bernstein (2002) suggests that scientific intuition is linked to the aesthetic response. Aesthetic response is that which is beautiful and is known by its sensory and emotional experience (Root-Bernstein, 2002). This is similar to Bohm's (1998) view that the scientist searches for harmony. Einstein linked intuition with visual imagery and Poincare' related it to non-visual sensible intuition (Miller, 1997). Aesthetics according to Miller (1997) plays an important role for scientists, for Einstein beauty was equivalent to how physical theories ought to represent nature.

Root- Bernstein (2002) suggests that intuition is preverbal, that is, the individual knows something before it is expressed in words. In fact, the author suggests that scientific problem solving and the generation of solutions involves the same creative processes involved in the arts (Root-Bernstein, 2002). Furthermore the experience of knowing what one feels and feeling what one knows he calls 'synoisa' (Root-Bernstein, 2002). That is the integration of emotion and knowledge as one. The author also suggests that there is a meta-logic to the intuitive responses. Meta-Logic is explained as a way of acting on an object or through a process to obtain a desired outcome, in a sensual way (dependant on the senses, e.g. visualising abstract concepts), independent of mathematical, linguistic or other formal logical structures (Root –Bernstein, 2002). The author proposes that aesthetic

cognition precedes and differs from formal logic and that before ideas can be tested they need to be communicated and only once this is done are they able to be tested logically (Root- Bernstein, 2002). These stages, it is posited, are the foundation for creative scientific thought.

2.13 CRITICISM OF INTUITION

There have been various criticisms about the use of intuition. It is argued that intuition is shrouded in mystery and has a somewhat romantic appeal (Bastick, 1982; Bonabeau, 2003) Moreover, the use of intuition elevates us from the ordinary and this, it is argued, is what makes relying on intuition so dangerous (Bonabeau, 2003).

Although intuition is a universal phenomenon it is influenced by cultural differences and the social context (Ruth –Sahd, 2003). This in turn influences how information is processed and integrated and whether intuition can be used to solve a problem. In the West it is less acceptable to use intuition as rationality and logic are given more credence (Ruth-Sahd, 2003). Consequently the influence of culture and context determine whether intuition is used to problem solve or make decisions.

Bonabeau (2003) suggests that intuition is dangerous as it can lead to groupthink. That is, in our homogenised world intuition is not unique to the individual but may reflect me-to- thinking (Bonabeau, 2003).

Bonabeau (2003) suggests that intuition is also effected by personal bias, which he argues operates at a subconscious level, which therefore effects intuition. Bias exists due to the fact that information is processed on the basis of past experiences and events; these are matched and facilitate recall (Hall, 2002). The ease of recall is another factor that may influence intuition as recall is linked to emotion, the more emotionally laden an event or experience is, the easier it is to recall and the more frequently it is recalled (Hall, 2002). This gives rise to the error in thinking that this set of facts occurs more

frequently than it does (Hall, 2002). It is in this way that an individual wants her intuition to fit a phenomenon.

Bias can also occur where the initial information is the basis for a prediction (Hall, 2002). This prediction is modified as further information becomes available. However, it is modified in terms of the initial prediction (Hall, 2002).

Another factor influencing intuition is the psychological make up of the individual (Hall, 2002). Hall (2002) suggests that individuals have an overly optimistic view of themselves, that is, an embellished perception of personal control and an impracticable optimism. The way information is processed may also lead to bias (Hall, 2002). That is, information that supports a hypothesis is more likely to be recalled than information that disproves a hypothesis (Hall, 2002). It is this bias that may negatively effect decision making or problem solving in that this information may be investigated with the purpose of minimising its relevance (Hall, 2002).

The most perilous flaw of intuition is the need to see patterns (Bonabeau, 2003). The need to see pattern, he argued is at the root of intuition in that our minds digest information based on the past in order to anticipate the future (Bonabeau, 2003). However, it is this need that misleads us. That is, choices can be altered depending on how information is presented (Hall, 2002). According to Bonabeau (2003), the need to see patterns frequently leads to perceptions of patterns where none exist.

Bonabeau (2003) acknowledges that intuition may have evolved from an evolutionary view in that it assisted in life or death situations where it was important to integrate unfamiliar information quickly. This, he suggests, is no longer the case and intuition is outdated as a mode of solving problems without careful analysis of the information (Bonabeau, 2003).

A further criticism has been levelled against intuition is that it is unconscious or subconscious and is thus unknowable (Wilson, 1998). Birgerstam (2002) argues that it is impossible to separate and define intuition in a rational way.

According to Birgerstam (2002), intuition and rationality lie along a continuum. Birgerstam (2002) suggests that it is the interplay between rationality and the intuitive that gives rise to the formation of new knowledge.

2.14.SUMMARY OF INTUITION

Various views on intuition have been discussed, ranging from intuition as inference arising out of cognitive processing of information to the intuition as a phenomenological experience that is captured with great difficulty as language falls within the domain of the cognitive and intuition as an unconscious means of processing information (Avridson, 1997; Burneko, 1997; Jung, 1954; Spotto, 1995; Westcott, 1968; Wilson, 1998).

The definition that Westcott (1968) used is broad enough to encompass the conscious behaviour of intuition and the unconscious process that gives rise to intuition and, consequently, this is the definition that I shall use when applying the term intuition. Intuition is described as the process of arriving at a conclusion on the basis of little information that is normally reached on the basis of significantly more information (Westcott, 1968). Intuition is also based on expertise as well as experience (Burneko, 1997; Ruth-Sahd, 2003;). Intuition, it has been argued, arises out of experience, that is, we learn through trial and error but this knowledge is not verbalised and accounts for the feeling of knowing without knowing how we know (Foltz-Gray, 2003).

Arvidson (1997) has examined intuition in terms of the attentional shift that describes the structure of the subject's ongoing awareness and how attention works in the structure of the intuition or insight.

Intuition in science has been explored in terms of the swift identification or a thing event or sign, clear understanding of the meaning or relationship of the signs, correct interpretation of the signs, representation ability i.e. imagining the visual representation of absent objects, skill in forming metaphors, creative imagination, inference, power of synthesis, common sense, sound judgement (Bunge, 1962).

Aesthetics plays an important part in scientific intuition as well as problem solving. It is this search for harmony and wholeness in order to understand nature that plays a role in developing new knowledge and theories (Bohm, 1998; Mindell, 2000; Root-Bernstein, 2002).

Both problem solving and intuition involve identifying the problem and evaluation of the solution (Root-Bernstein, 2002). In scientific intuition this involves testing the intuition (Bunge, 1962). Intuition involves a period of rumination over a problem and suspending cognitive thought about the issue (Bohm, 1998; Miller, 1997; Mindell, 2000). It also involves a subjective experience, which is connected to emotions (Pitcher, 1999; Root-Bernstein, 2002; Wanless, 2002). Both problem solving and intuition look at the relationships between different facts or domains of knowledge (Bohm, 1998; Mumford et al., 1996).

It is this relationship between problem solving and intuition that has an influence on career counselling. In that this may influence the career that the individual chooses. It also impacts on the manner in which career counselling is carried out.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter will focus on the research design and instruments used to investigate the relationship between problem solving, and intuition -sensation as conceptualised by Jung and the 19 Field Interest Inventory. The two tests that were used in the investigation are the Jung Personality Questionnaire (JPQ) and the 19 Field Interest Inventory (19FII). Both tests will be discussed. Three items from the 19 Field Interest Inventory were used in this research, namely numerical, scientific interest, and creative thought. These fields were selected as the literature suggests that science and mathematics are connected to intuition (Bohm, 1998 Dunbar, 1995, Mindell, 2000, Miller, 1997). Engineering is a field of science that operates within fixed parameters to solve various problems and this requires creativity. These are the reasons that these items were selected to measure the concept creative thought or problem solving.

3.2 RESEARCH DESIGN

A quantitative approach to research is used to systematically analyze patterns in data in order to understand social life (Neuman, 2000). In this instance the research is examining whether a correlation exists between problem solving and intuition/sensation. A quantitative approach is used in this research in order to test whether a relationship exists between high scores in intuition and high scores in the subject *Introduction to Innovation* (Neuman, 2000). This knowledge is important as it has implications for career counsellors in terms of making recommendations about prospective fields of career. Furthermore, the establishment of this relationship may have implications in that intuition may be a predictor in an above average performance in this subject.

3.2.1 Population

The accessible experimental population was drawn from the students that visited Student Support at the University of Pretoria for career guidance during 2000 – 2002. Simple random sampling was used to determine the experimental group (Huysamen, 1993).

| Year | Females | Males | Total |
|--------------|------------|------------|------------|
| 2000 | 178 | 99 | 277 |
| 2001 | 151 | 113 | 264 |
| 2002 | 155 | 120 | 275 |
| Total | 484 | 332 | 816 |

Table 3.1 Experimental Population (n=816)

The experimental population consisted of 816 students that visited the Department of Student Support in 2000-2002. From this group a sample population of 72 engineering students was drawn. This group consisted of students who were registered for an engineering degree. From this sample of 72, a group of 50 were selected that completed the course. However, marks for 16 subjects were not available in part as the subject was only introduced in 2001 and some of the subjects were in their second or third year and thus did not register for this course one subject received credit for the course and two stopped the course, and one was absent for the exam. Thus the sample group was reduced to 30 subjects. This is indicated in table 3.3

| Males | Females | Total |
|-------|---------|-------|
| 51 | 21 | 72 |

Table 3.2 Target Population (n=72)

| Males | Females | Total |
|-------|---------|-------|
|-------|---------|-------|

| | | |
|----|----|----|
| 18 | 12 | 30 |
|----|----|----|

Table 3.3 Sample population (n=30)

Introduction to Innovation is a standard course for all the engineering disciplines. This course consists of basic engineering skills and problem solving skills such as problem identification, idea generation, evaluation, and implementation (Regulations and Syllabi, 2003, UP). According to the course description, as contained in the faculty guidebook of 2003 a strong emphasis is placed on creativity and innovation.

3.2.2 Psychological Instruments

The data was drawn from the results of career tests completed by the students that visited the Department of Student Support during the years 2000-2002. Students were expected to complete a battery of four tests namely, the South African Vocational Interest Inventory (SAVII), a paper and pencil test, and three computer based tests; Jung Personality Questionnaire (JPQ), 19 Field Interest Inventory (19FII), and the Senior Aptitude Test (SAT). This research focused on intuition and sensation and problem solving and thus the results from the JPQ and the 19 FII were used. The 19FII was used as it indicates specific interests, as opposed to the SAVII, which is more general in its indication of interests.

3.2.3. Data Analysis

The statistical tests that were applied to the data are Spearman's correlation coefficient and the chi-squared test. A brief discussion will follow indicating the rationale for using these specific tests.

The Spearman correlation co-efficient test is used where data is ranked or collapsed into broad categories such as high and low. It is also used as a

measure of association between two variables (McCall, 1986). This test is useful in identifying linear and non-linear relationships (Peck, Olsen & Devore, 2001). Statistics that test correlations are used in order to determine whether there are relationships between variables (Werbelloff, 1996). In this instance, the tests looked at whether a relationship existed between intuition /sensation and the items, creative thought, scientific and numerical interest. Each variable was categorised as high or low.

The Chi-square test is used, as it does not require any assumption about the exact shape of the population distribution. This test is also appropriate for nominally ordered variables (Howell, 1992). In this research the variables are ordered in terms of high or low interest and preference of function intuition/sensation.

The purpose of the Chi-square is to test the statistical significance of the association between the categories (Coetzee & Shreuder, 2002). That is, to investigate whether membership of a category in one dimension is associated with membership of a given category. In this case the test was used as categories are used, that is, subjects that indicate that they scored high on intuition/sensation and the items in the 19FII(creative thought, science, and numerical interest). The Chi-squared test will indicate if there is a relation between high scores in intuition/sensation and creative thought, science, and numerical interest (Werbelloff, 1996).

3.3 PSYCHOMETRIC INSTRUMENTS

3.3.1 Jung Personality Questionnaire

The Jung Personality Questionnaire (JPQ) is based on the MBTI (Sharf, 1997). This test has been widely used for vocational guidance in order to obtain a broad picture of the individual's personality structure (Du Toit, 1995).

The JPQ consists of an Afrikaans and English questionnaire (Du Toit, 1995). The questionnaire consists of 75 items. The testee must indicate which of the two activities he/she prefers. If the testee is uncertain he/she is given an opportunity of stating such. There are thus three possible answers. For example :

You must

- (a) address a meeting
- (b) greet guests
- (c) uncertain

The opposing tasks fall along a continuum. The choice between the two tasks is indicative of the attitude or function that is preferred. These attitudes and functions are combined and result in the psychological types (Du Toit, 1995).

The variables that were investigated in this research were Intuition and Sensation. This factor falls along a continuum. The raw scores were then converted to stanines. Thus scores from 0-4.50 indicate that the individual scores high on intuition. Scores from 5-9 indicate that the individual scores high on sensation. If the individual scores high on intuition or sensation then this appears to be the dominant function (Du Toit, 1995).

The reliability of the JPQ is regarded as satisfactory (van Staden, 1992). The reliability coefficient on the Extroversion and Introversion scale is 0.8. The scale for Sensation and Intuition has a reliability coefficient that is higher than 0.8. The inter-correlation between the scale of Extraversion and Introversion and Sensation and Intuition are independent of one another (Du Toit, 1995).

Smit (1991) states that research by Du Toit (1987) indicates a link between personality types and careers of standard 10 boys and girls. According to Smit (1991) this research is indicative of the predictive validity of the JPQ.

In the correlation of the JPQ with the HSPQ (High School Personality Questionnaire) it was found that there was a strong relationship between the extraversion and introversion scale on the JPQ and the variables A, F, E, H and Q2 on the HSPQ, which also measure these concepts. This it was argued indicated high construct validity even though the definitions of extraversion and introversion differed between the tests (Du Toit, 1995).

3.3.2 Research relevant to the Jung Personality Questionnaire (JPQ)

Research by Viljoen (1992) focused on 182 individuals from eight artisan groups; hairdressers, boilermakers, electricians, fitters and turners, jewellers, mechanics photolithographers (printers), and aircraft machine setters (Viljoen, 1992). According to this research a statistically significant difference was found between the mean of each group in terms of the four subscales. Further research indicated that hairdressers differed from the other groups. According to van Staden (1992), this may be due to the fact that gender may have played a role and that this variable was not controlled in the research. The careers of boilermakers, aircraft machine setters and fitter and turners accorded with the personality types and careers as suggested by the JPQ (Viljoen, 1992). This research indicated a difference in terms of the personality types of electricians, jewellers, and hairdressers (Viljoen, 1992). Accordingly, it was concluded that this indicated a tentative support for the JPQ as applied to artisans.

A great deal of research has been conducted on the Myers-Briggs Type Indicator (MBTI) (Sharf, 1997). This test is also based on Jung's typology and is included as the JPQ measures the same functions and attitudes. This test was designed to determine the individual's basic preferences in terms of the general attitudes and functions (Myers, 1962).

Research at high school investigated the psychological types and interests (Myers & McCauley, 1985). The subjects had to indicate their preference for

certain fields of study, science, maths, English, history, music, art and practical skills (van Staden, 1992). The research indicated a statistically significant link between the preferences in the differing study fields. Six out of the eight sensation types, as specified by the JPQ, indicated a preference for practical skills whilst none of the intuition types showed this preference (Myers & McCauley, 1985). The research indicates that maths as an interest was frequently chosen by individuals whose dominant function was Sensation-Thought (Myers & McCauley, 1985). The study also indicated that those whose dominant function appeared to be Intuition –Thought, often selected science. This research indicates that individuals with specific psychological types show preferences for specific fields of study (Myers & McCauley, 1985).

The research has indicated that there is some support for Jung's theory on typology (van Staden, 1992). In research conducted by Moody (1988), at the University of Hawaii it was found that in a group of 491 students all of the 16 types of personality as defined by the MBTI were present (Moody, 1988). In terms of this research the personality type that was the most common was EFNP (Extravert Feeling Intuition Perception) and the least representative type was EFSP (Extravert Feeling Sensation Perception) and IFSP (Introvert Feeling Sensation Perception) (Moody, 1988). According to this research those students that studied science indicated a preference for Intuition-Thought (Moody, 1988).

According to Cowan (1989) there is doubt about whether the MBTI is sensitive enough to measure Jung's theory. The MBTI was evaluated in terms of Jung's theory of typology and the five-factor model used by the NEO-PI (NEO-Personality Inventory). This study used data from 267 men and 201 women aged 19 –93. McCrae and Costa (1989) suggest that there was no support for the view that the MBTI measured preferences in terms of the attitudes and distinct personality types. These authors further suggested that either Jung's theory is incorrect or the MBTI has not comprehensively operationalised the theory (Healy, 1989; McCrae & Costa, 1989; van Staden, 1992).

Ramaprasad and Mitroff (1984) suggested that in terms of organisational problem solving, which is a subsection of problem solving; the MBTI fails to consider the person's total number of function strengths. Cowan (1989) proposes that this has occurred as the MBTI only identifies the most dominant function and attitude. This, according to the author, indicates that Jung's concept of differentiation has not been sufficiently operationalised.

The concept of differentiation among the functions states that one function usually becomes more dominant in the processing of information (Spoto, 1995). Jung (1923) also stated that the other functions, the less differentiated functions are less developed and are part of the unconscious and, as such, the conscious exercises little control over them. He further states that the less differentiated functions have some degree of consciousness and thus exert some degree of influence on decision- making (Jung, 1923).

Cowan (1989) proposes that instead of measuring the functions on a dichotomous scale, questions should be developed that indicate preference and strength of preference for a function. This, it is suggested, will indicate the individual's differentiation in terms of the four functions. The research based on this supposition found that there were weak correlations between sensing and intuiting. This, it is suggested, indicates that some individuals are strong on both functions and the MBTI is not sensitive enough to pick up this information (Cowan, 1989).

According to Ramaprasad and Mitroff (1984), the number of function strengths an individual manifests is important in activities such as problem formulation. Thus, it is clear that the MBTI does not explore the concept of differentiation sufficiently and important information is lost.

Further research by Furnham, Moutafi and Crump (2003) indicates that the Revised NEO Personality Inventory (NEO PI-R) and the MBTI do show correlations between the general attitudes of Extraversion as conceptualised by the NEO-PI and the Extraversion –Introversion measure on the MBTI. This research also indicated that there was a correlation between Openness on the NEO PI and the functions of Sensing –Intuiting as proposed by the MBTI.

It is apparent from the research that there is some support for Jungian Typology as measured by the JPQ and the MBTI (Furhnam et al., 2003; Moody 1988). The shortfalls appear to be the manner in which the concepts are measured and the way in which the tests are designed, which leaves out important information (Cowan, 1989).

3.3.3 Evaluation of the JPQ

According to Smit (1991), information from the JPQ should only be used for career counselling. He further cautions that the results obtained from the JPQ should always be used in conjunction with information about interest and aptitude (Smit, 1991). Further caution is expressed by van Staden (1992), he proposes that a great deal of research has been done in schools but that further research is needed to support the principles underlying the JPQ in the broader South African population. This author further cautions that there is insufficient research on the applicability of the JPQ on adults. Moreover, the research that has been conducted was done on white scholars and, as such, the applicability to other cultural groups is questionable (van Staden, 1992;). van Staden (1992) states that there is no test –retest study on the JPQ and that there is little research on the constancy of the scores with the passing of time.

The careers listed in the appendix of the JPQ are not clear and are a little out of date in terms of the degrees that are offered in respect of careers for instance the careers of accountant and auditor. The appendix indicates that an accountant

requires a three- year degree whereas an auditor it states must have a six- year degree (Viljoen, 1992).

van Staden (1992) states that only the three subscales of Introversion and Extraversion, Intuition- Sensation, and Thinking-Feeling are used in the JPQ for career counselling. He suggests that the fourth scale of Judgement-Perception should also be used.

3.3.4 The 19 Field Interest Inventory (19FII)

The 19FII is based on the Californian Occupational Preference Scale (Kapes & Mastie, 1988). The 19 FII is one of the most popular interest inventories used in South Africa. It is normalised for pupils in grades10-12 and is widely used for adult career guidance (Holman, 1995). The 19 FII was designed to determine broad areas of interest (Smit, 1991).

The test lists 285 activities and testees indicate which of these they would like to do, choice is made irrespective of ability. The items include work and leisure activities (Fouche & Alberts, 1971). The 19 items can be grouped in six areas that indicate a specific study direction, aesthetic (humanities), social service (social sciences), intellectual scientific (sciences), practical (engineering and trades), business and law (commerce), and outdoors (Fouche & Alberts, 1971). The 19 FII can be interpreted in terms of groups of interest and compared with career profiles.

The raw scores of each item are converted to stanines from 1-9 with an average score being 5 and a standard deviation of 1,96 (Smit, 1991). Thus, scores from 5-9 indicate an above average interest in a specific field.

The inventory measures the extent to which a person is interested in the 19 fields (Smit, 1991). Interest is defined as an unvarying optimistic or enthusiastic

directedness towards a specific activity (Fouche & Alberts, 1971). The inventory consists of questions that refer to certain pursuits that are the foundation for certain occupational fields. The directedness of the individual's response indicates interest in a particular field (Smit, 1991).

According to Smit (1991), the reliability of the 19 FII is 0,90 to 0,98, which is high. The differing areas of interest indicate a reliability coefficient of 0,68 and 0,81, which is regarded as satisfactory (Smit, 1991). De Bruin (2002) indicates that the split half reliability coefficients range between 0,88 and 0,98 for high school boys and girls and is regarded as satisfactory.

The interdependence between the 19 fields is low (Smit, 1991). When interpreting the 19 FII it must be borne in mind that an individual's interest is dependant on personality development and that interest is subject to change (Smit, 1991). Hogan and Blake (1999) propose that interests are indicative of values, aspirations and ideals.

Smit (1991) states that the validity of the 19 FII is high. Nicol (1978) suggests that the face validity of the 19FII is high. Smit (1991) proposes that the fields are independent of one another and that each measures a specific interest. The construct validity of the 19FII is satisfactory as it is based on extensive item analysis, which indicates that the fields are well-defined constructs (Holman, 1995)

3.3.5 Research relevant to the 19FII

Research comparing the Kuder Interest Inventory (KII) and the 19 FII indicated that all the fields of the KII were covered by the 19 FII. This research also found that 19 FII covers ten fields that are not covered by the KII (Holman, 1995).

De Bruin (2002) researched the relationship between personality traits and interests using the 19FII and the 16 Personality Factor Questionnaire (16 PF). The research indicated that the factors Extraversion, Tough Poise and Independence were correlated with vocational interests. A high score on Independence was associated with a critical and domineering style and a low score with a more submissive attitude. The item in the 19 FII that had a meaningful relationship with this factor was Creative Thought. This, according to De Bruin (2002) suggests that individuals who scored high on Independence like to produce novel and unique ideas.

Creative Thought is one field in the 19FII that measures creativity and problem solving in a unique manner (Smit, 1991). According to this author, this includes living out ideas and thoughts in the individual's career. Smit (1991) further states that individuals scoring high on this item tend to be independent in that approval for ideas or thoughts are not sought. This field together with the individual's score on the JPQ may indicate a correlation between Creative Thought and the engineering student's preferred function of intuition or sensation.

The field of science applies to the physical and biological sciences (Smit, 1991). According to Smit (1991), underlying this interest is the need for order and systematic planning. The numerical field applies to communication and in particular communicating exact and accurate information (Smit, 1991).

De Bruin and Du Toit (1995) researched the 19 FII and Holland's fields of interest. Holland proposes that interests can be categorised along six fields; Realistic, Investigative, Social, Artistic, and Conventional (Sharf, 1997). According to Weinrach and Srebalus (1990), individuals who are investigative are often analytical, precise, and methodical. The research indicated that the fields in the 19 FII Creative Thought, Science and Numerical were strongly linked to the Investigative fields in Holland's theory (De Bruin & Du Toit, 1995). De Bruin and Du Toit (1995) argued that this together with the low loading obtained on the

Social field indicated that investigative individuals prefer to work with abstract rather than concrete facts. Overall this research indicated that Holland's fields were closely linked to the 19 FII.

3.3.6 Evaluation of the 19 Field Interest Inventory

One of the main criticisms of the 19 FII is that it is not based on any particular theory (De Bruin & Du Toit, 1995). The test was developed in 1971 and to date has not been revised and, consequently, certain items are out dated, for instance occupations involving computers, health/aerobics and human movement are not included (Holman, 1995). However, the test is widely used as a great deal of information is drawn from it. Sundberg (1977) proposes that interest tests are static and do not reflect social changes, as they are based on existing models and fields they continue the status quo.

The 19 FII is a useful test in providing information for career counselling as it provides more specific information on interests than the six broad categories mentioned in the Self Directed Search (SDS) (De Bruin & Du Toit, 1995). These authors suggest that although the 19 FII provides areas of interest these are not specific enough. This, it is argued, is due to the fact that some of the fields are highly correlated with each other. There are two fields that need more differentiation, as they can be misleading. These two fields are numerical and scientific. Smit (1991) suggests that these fields should be divided into biological and physical sciences and an interest in maths and accountancy.

The 19FII is a fairly transparent test where every nineteenth item applies to a particular field. Consequently testees notice that the lines across the answer sheet apply to the same field and can thus fake their responses (Holman, 1995).

However the test is still in use and this indicates that despite certain shortcomings it is still adequate for use in vocational guidance.

3.4.CONCLUSION

This chapter has briefly discussed the research design and the psychometric tests used in this investigation. The Jung Personality Questionnaire is based on the MBTI and, as such, there is some criticism about whether the dichotomous testing for responses truly operationalizes Jung's theory on differentiation and if not, then valuable information regarding the auxiliary functions are lost (Cowan, 1989). Despite this, the information provided by the JPQ is helpful in assessing personal styles of interacting with the world, which can be related to vocational guidance (Lindley & Borgen, 2000).

The 19FII is a widely used inventory in SA and despite the fact that it has not been revised, still contains a great deal of information regarding the individual's interest. It is this information that is useful in vocational guidance (Holman, 1995; De Bruin, 2002). It is apparent from the above discussion that the 19 FII is a sound psychometric test in that its reliability and validity are satisfactory (Smit, 1991; Nicol, 1978).

CHAPTER FOUR ANALYSIS OF RESULTS

4.1 INTRODUCTION

This chapter will provide an analysis of the results obtained by the subjects on the two psychometric tests (JPQ and 19FII) as well as the results obtained by the subjects registered for the course *Introduction to Innovation*. A discussion will ensue before each table. The earlier discussion of the literature around the topic of creative thought and intuition will also be discussed in light of the results in a separate section.

4.2 RESULTS OF THE DATA

This section will deal with the results obtained in the study. The Chi-squared test and Spearman's Correlation Coefficients were used and the results obtained from these tests will be discussed.

The hypothesis is whether there is a relationship between creative thought as conceptualised by the items in the 19 FII (creative thought, science, and numerical) and intuition as conceptualised by the JPQ. The second part of the investigation determines whether there is a correlation between intuition and the results obtained by the subjects in a course aimed at using creative thought in the engineering sciences.

The initial sample of 72 engineering students was used to examine the relationship between creative thought and intuition. Three Chi –squared tests were done with each of the variables, numerical, science and creative thought. Thereafter a Spearman's correlation was done on all the variables using this sample group.

In order to determine the relationship between the results obtained for the course *Introduction to Innovation* and Creative thought, an analysis of the percentages was done as well as Spearman's Correlation Coefficients.

4.3 CHI –SQUARED TESTS

4.3.1 Science and Intuition and Sensation

The first chi-squared test examined science in terms of intuition–sensation (N/S). Table 4.1 indicates that 17,33% of the total sample population fell within the (N) intuition high interest in science category, whilst 30,66% of the sample fell within the intuition (N) low interest in science category. In terms of sensation (S) 7,22% of the sample group fell within the sensation (S) high interest in science category while 12,77% of the sample fell within the sensation (S) low interest in science category. In terms of the categories 63,04% of the low interest in science fell within the category intuition (N), while 30,43% of the low interest in science fell within the sensation category. The category of high interest in science is 73,08% also falls within the intuition (N) category, whilst 23,08 % of the category high interest in science fell within the sensation (S) category. On the face of these results this may indicate a slight tendency that a high interest in science is related to an intuitive way of processing information.

However, the probability of this statistic is 0,6741, which is not meaningful. It is apparent from this test that there is no correlation between an interest in science and intuition/sensation. Intuition/sensation is used in this research as conceptualised by Jung (1954), that is, intuition-sensation falls along a continuum. The chi-squared test indicates that out of a sample of 72 ,four individuals used neither sensation nor intuition exclusively and this may have skewed the data for all the chi-squared tests as there were insufficient numbers in the cell category intuition-sensation (N/S).

| | | | |
|----------------------------------|----------------|----------------|--------------------|
| Frequency Expected Percent | Science 1-5 | Science 6-9 | Total |
| N | 30,66 | 17,33 | 66,67 |
| 0-4.5 | 63,04 | 73,08 | |
| Sensation | 12,77 | 7,22 | 27,78 |
| 5.0-10 | 30,43 | 23,08 | |
| N/S | 2,55 | 1,44 | 5.56 |
| 4,5-5.5 | 6,52 | 3,85 | |
| Total | 46 | 26 | 72 |
| | 63,89 | 36,11 | 100 |
| Statistics | DF | Value | Probability |
| Chi-Squared | 2 | 0,7886 | 0,6741 |

Table 4.1: Frequency distribution and Chi-Square test of Intuition and Sensation versus Science Interest

4.3.2. Numerical Interest and Intuition and Sensation

This test examined the item numerical interest and intuition (N) and sensation (S). Of the total sample group, 35,33% fell within the intuition high numerical interest category. In terms of the category, 67,92 % fell within the intuition (N) high interest in numerical, category. Out of the whole sample group 14,72% fell within the sensation high interest in numerical category. In the category high interest in numerical 26,42% of the sample fell within the category sensation (S). This seems to indicate a tendency that being interested in working with numbers is linked to intuition. However, the probability is 0,9112, which is not meaningful. Thus, no inference may be drawn that there is a relationship between an interest in the item numerical and intuition (N).

| | | | |
|-------------------|--------------|---------------|--------------------|
| Frequency | Numerical | Numerical | Total |
| Expected | 1-5 | 6-9 | |
| Percent | | | |
| N | 12,66 | 35,33 | 66,67 |
| 0-4.45 | 63,16 | 67,92 | |
| S | 5,27 | 14,72 | 27,78 |
| 5-10 | 31,58 | 26,42 | |
| N/S | 1,05 | 2,94 | 5,56 |
| 4.5-5-5 | 5,26 | 5,66 | |
| Total | 19 | 53 | 72 |
| | 26,39 | 73,61 | 100 |
| Statistic | DF | Value | Probability |
| Chi-square | | | |
| | 2 | 0,1859 | 0,9112 |

Table 4.2: Frequency distribution and Chi-Squared test between Intuition and Sensation versus Numerical Interest.

4.3.3 Creative Thought and Intuition and Sensation

Of the total sample population, 41,33% have a high interest in creative thought and fall within the category intuition (N), whilst 17,22% of the sample population of a high interest in creative thought fall within the category sensation (S). In terms of the categories, 70,97% fall within the intuition high interest in creative thought category, whilst 24,19 % of those with high interest in creative thought fall within the sensation category.

The probability statistic is 0,1560, which is not meaningful. There is thus no correlation between a high interest in creative thought as conceptualised by the 19 FII and various authors (Dudek & Cote, 1994; Rothenberg & Hausman, 1976; Runco & Chand, 1994;) and intuition as determined by the JPQ and

various authors (Jung, 1923; Westcott,1968;Wilson,1998; Root- Bernstein ,2002).

| Frequency expected | Creative thought 1-5 | Creative thought 6-9 | Total |
|--------------------|-------------------------|-------------------------|--------------------|
| N | 6,66 40,00 | 41,33 70,97 | 66,67 |
| N/S | 0,55 10,00 | 3,44 4,84 | 5,56 |
| S | 2,77 50,00 | 17,22 24,19 | 27,78 |
| Total | 10 13,89 | 62 86,11 | 72 100 |
| Statistics | DF | Value | Probability |
| Chi Square | 2 | 3,7161 | 0,1560 |

Table 4.3: The Frequency distribution and Chi-Squared test of N-S (Intuition – Sensation) versus Creative Thought Interest.

4.4 SPEARMAN’S CORRELATION COEFFICIENT

Intuition and sensation are grouped together on a continuum. The smaller the values in the intuition factor, the greater the intuition factor is, the larger values indicate sensation as the function used to perceive the world.

Table 4.4 indicates a negative correlation $-0,20$ between creative thought and intuition –sensation (N-S) index. This indicates that there is a slight tendency that an increase in intuition would correlate with a higher interest in careers involving creative thought because of the negative correlation.

There is a positive correlation between the items numerical (0,06) and creative thought (0,0818), whilst science is negatively correlated (-0.16) with the N-S index and numerical has a positive correlation with the N-S index.

The results seem to infer that the more inclined a person is to process information using sensation that there may be a tendency indicating an interest in numbers and possibly a career involving this interest.

In order for the Spearman's Correlation Coefficient to be meaningful probability statistics of 0,05 or 0,03 should be obtained. In this test it is apparent that there is no statistical significance. Accordingly, there is no significant relationship between intuition and creative thought.

| N-S | N-S | Creative thought | Science | Numeric |
|------------------|---------------|------------------|---------------|----------------|
| N-S | 1,00 | -0,20 0,08 | -0,16 0,17 | 0,06 0,6 |
| Creative Thought | -0,20 0,08 | 1,00 | 0,25 0,03 | 0,51 <,0001 |
| Science | -0,16 0,17 | 0,25 0,03 | 1,00 | 0,35 0,00 |
| Numeric | 0,06 0,60 | 0,51 <,0001 | 0,35 0,00 | 1,00 |

Table 4:4:Spearman Correlation Coefficient (n=72) in order to determine the correlations between variables. Probability > [r] under Ho: Rho=0

4.5 CENTRAL LIMIT THEOREM

4.5.1 Mean and Median

In order to provide an overview of the results obtained, a means table is provided (table 4.5). From this table the measure of central tendency and spread will be indicated. The central tendency theorem determines the score around which the scores centre. In this instance, the mean for N-S is 3,90, indicating that the sample group had low scores for intuition, indicating a greater value in the intuition variable. The table also shows that the sample

group had a high interest in creative thought (6,86) and numerical interest (6,51), whereas the mean for science is 4,90 indicating a low interest in this field.

The median is used in this instance as the scores for the items creative thought, numerical and science might have extreme outlying scores and this may be due to the fact that they are only measured in terms of stanines. Therefore the range effect may be present in the items creative thought and numerical as the items do not make provision for individuals who score higher than nine and as a result this may cause the scores to cluster at the high end of the scale.

| Variable | N | Mean | Std Deviation | Median | Minimum | Maximum |
|------------------|----|------|---------------|---------|---------|----------|
| N-S | 72 | 3.90 | 2,04200 | 3,87500 | 0 | 9,500000 |
| Creative Thought | 72 | 6,86 | 1,49464 | 7,00000 | 3,00000 | 9,00000 |
| Science | 72 | 4,90 | 1,61994 | 5,00000 | 1,00000 | 8,00000 |
| Numerical | 72 | 6,51 | 1,47269 | 7,00000 | 4,00000 | 9,00000 |

Table 4.5: Simple statistics: Means and Median

4.6 ANALYSIS OF VARIABLE PERCENT

The next stage of the investigation determined whether there was a correlation between the marks obtained by the subjects in the course *Introduction to Innovation* and the scores obtained on the continuum of intuition –sensation (N-S).

Table 4.6 indicates that the marks are spread out fairly equally, indicating no real difference between those whose dominant irrational function is intuition and those whose dominant function is sensation and those who use both.

This indicates that there is no relationship between creative thought and intuition.

| Jung | N | Mean | Std Deviation | Mimimun | Maximum |
|------|----|-------|---------------|---------|---------|
| N | 18 | 67,22 | 6,89 | 58,00 | 85,00 |
| N/S | 4 | 66,50 | 7,04 | 58,00 | 75,00 |
| S | 8 | 69,50 | 5,18 | 61,00 | 75,00 |

Table 4.6: Analysis Variable: percent The Means. (N=30)

4.6.1 Spearman's Correlation Coefficient

This indicates a negative correlation between intuition and science. In order for this to be significant, scores of 0.03 or 0.05 need to be obtained. The negative correlation in this instance is $-0,29$, which is not significant. This test confirms the earlier test on the sample group of 72, which indicates that there is no correlation between intuition –sensation and creative thought.

| n-s n-s | n-s | Science | Numeric | Percent |
|------------------------|---------------|---------------|--------------|---------------|
| n-s n-s | 1,00 | -0,29 0,11 | 0,13 0,46 | 0,21 0,26 |
| Science Science | -0,29 0,11 | 1,00 | 0,49 0,00 | -0,05 0,77 |
| Numerical Numerical | 0,13 0,46 | 0,49 0,00 | 1,00 | 0,07 0,71 |
| Percent | 0,21 0,26 | -0,05 0,77 | 0,07 0,71 | 1,00 |

Table 4.7: Spearman Correlation Coefficients, N=30 Prob>[r] under HO :Rho =0 (n=30)

4.6.2 Summary

It is apparent from the above results that there is no relationship between intuition and sensation and creative thought. It is also clear that there is no relationship between a high interest in creative thought, science or numbers and intuition. One of the reasons for this might be the small target group of 30 students. Due to the variation in the sample size it became apparent that it was not possible to arrive at statistical inferences relating to the correlation between creative thought and intuition-sensation. Another factor that may have influenced the study was that four variables were examined simultaneously.

4.7 DISCUSSION

The literature discussed in chapter two indicated that there is a link between creative thought and the process involved in creative thought and intuition. The data above indicate that there is no link between creative thought and intuition. This section will provide a brief overview on the literature and various factors will be discussed. This may provide some explanation for the results obtained which are contrary to the literature reviewed.

4.7.1 Creative Thought as a Cognitive Process

This section will deal with the literature that views creative thought as a cognitive process. Various aspects of the stages of creative thought will be discussed as well as the variables involved in this process that may have impacted on the present study.

If one examines the stages of creative thought the first stage appears to be problem finding or determining the problem (Patrick, 1937). The data measured the subjects' performance in the course *Introduction to Innovation*. This is a first year course. There is no data on the manner in which the students began to problem solve or define their problems or whether they perceived these problems as solvable (Kay, 1994; Runco & Chand, 1994).

Dudek and Cote (1994) suggest that in order to perform well there must be some level of emotional involvement in the task.

The sample group was drawn from students that approached the Department of Student Affairs in order to obtain guidance about career choice. This indicates that the students tested were either unsure about their choice of careers or wanted confirmation about their choice. This uncertainty or confusion may have affected their performance in the course *Introduction to Innovation* and this may account for the even spread of marks. Further, this confusion may have influenced the motivation and involvement of the students in their performance. These variables were not accounted for and may have influenced the results

The literature review touched on the process of information processing (Guilford, 1950; Mumford, 2001). Information processing investigates how associations are made and how information is manipulated. This variable was not measured and, as such, there is no data on the process used to form associations or process information and the length of time that it took to process such information and the strategies used to search for information (Mumford et al., 1996; Quin & Simon, 1990). Furthermore, the literature indicates that problem solving is enhanced with more expertise in various domains (Chi, et al., 1989). The students in this course were first year students and it is improbable that they possessed any level of expertise and this may have impacted on their performance. The premise behind information processing is that the greater the use of abstract concepts the greater the ease with which individuals will be able to produce new ideas (Tieszen, 2000).

Runco and Chand (1994) suggest that when it comes to evaluating the solution, individuals are not objective about their work. Another factor that may have influenced the data is that the external and interpersonal context was not considered. Thus, the factors involving social validation may have played a part in determining the performance of the students enrolled for the course *Introduction to Innovation*. The individual's own subjective judgement

about the aesthetics and usefulness of his idea or solution is another factor that was not considered. In terms of the literature this can also influence the evaluative process and implementation process.

The only data that was before me were the marks obtained. There was no information about the factors of fluency, flexibility and originality as conceived of by Guilford (1950). Fluency involves generating a large number of ideas and there is no data on this factor. Flexibility involves the use of strategy. That is to change strategy in the manner in which the problem is approached and discard information. Originality touches on truly unique and novel ideas or the application of such ideas. The above factors were not examined and depend on either observation or self-report. Thus the scope of this research did not cover these dimensions and factors.

4.7.2 Creative Thought as an Unconscious Process

Various writers have proposed that creative thought is an unconscious process and cannot be measured (Cannon, 1945; Freud, 1908; Jung, 1923). Perhaps this accounts for the results obtained in the data. The research only investigated the relationship between perceiving or processing information using the intuitive function. It did not investigate the role of the collective unconscious or the personal unconscious of the subjects and how these factors may have influenced the subjects' performance or interest in creative thought.

Others such as Blanshard (1964), Kris (1952) Koestler (1964), Rothenberg and Hausman (1976) suggest that the process operates on both a conscious and unconscious level and it is through this interface that new links are made between previously unconnected frames of reference. One of the ways of measuring the conscious creative thought process is to observe behaviour and interview the subject as to his/her choice of solution. This requires a more qualitative approach as opposed to the quantitative approach applied in this investigation.

Many scientists have provided anecdotal material about how they arrived at novel solutions (Miller, 1997). It appears from these accounts that arriving at a solution is often preceded by a period of inactivity or focusing on something else. This ties in with the stage of incubation as described by Patrick (1937). There is no information on this variable in the research and this may indeed also have affected the data.

Authors such as Mindell (2000) and Bohm (1998) suggest that creative thought is generated whilst in an alternated state of consciousness. In order to ascertain whether this is correct and whether this indeed influenced the research, the students' behaviour and self reports needed to be investigated.

The discussion also touched on some principles in quantum mechanics and how these may influence the production of creative thought. This is an important factor as it examines the paradigm from which the scientists and in this research the engineering students worked from. The paradigm they worked from could, in light of the uncertainty and field theory, influence the perception of information and the organisation of information for a solution or novel idea (Heisenberg, 1958; Sheldrake, 1995). The researcher did not investigate the paradigm used by the engineering students and this may have had an impact on the way in which they problem solved and processed information.

Furthermore, the discussion highlighted the fact that all experience can be structured through concepts (Bohm, 1998; Mumford, 2001; Tieszen, 2000). There is thus a subjective element that cannot be accounted for in terms of perception, if the perception of structures is subjective.

The reason that there is no correlation between creative thought and intuition may be due to the fact that the item creative thought is derived from a test that is not based on any particular theory (De Bruin & Du Toit, 1995). As such, the notion of creative thought as contained in the 19FII may be at odds with the concept of intuition in the JPQ, that is, the idea of intuition as conceptualised by Jung. Smit (1991) suggests that the fields numerical and scientific interest

may be misleading in that they should be divided into biological and physical sciences and maths and accountancy. These two fields were included in the research in order to extend the span of creative thought to these fields. This may have been too inclusive and interfered with the factor creative thought.

4.7.3 Summary

The above discussion mentions variables that could have influenced the current study. The variables that may have influenced the study are how the students defined the problem, whether the task was perceived as achievable, as well as the manner in which information was processed and associations made (Kay, 1994; Mumford et al., 1997). Factors such as fluency, that is, generating solutions, changing strategy (flexibility) and originality were not controlled for (Guilford, 1950). The variables influencing implementation, evaluation, and monitoring as well as the social validation of the solution cannot be underestimated and these may also have impacted on the study (Dudek & Cote, 1994; Runco & Chand, 1994).

In terms of creative thought as an unconscious process various variables that cannot be accounted for may have influenced the data. In the first instance, writers such as Freud (1908) and Jung (1923) propose that the process of creative thought is unconscious and it is impossible to observe it by virtue of it being unconscious. If creative thought is partly conscious and partly unconscious as Blanshard (1964), Kris (1952), Koestler (1964), Rothenberg and Hausman (1976) suggest, the only way to observe the interface is through behaviour and then to infer what the unconscious process is. This is beyond the scope of the present study.

Another variable that influences creative thought is the collective unconscious and it does so through symbols (Jung, 1923b; Jung, 1969). This particular feature was not investigated and it is not possible to ascertain whether it impacted on the process of problem solving.

A process that was not observed was the process of incubation (Patrick, 1937). This may be involved in the 'aha' experience and the subjective knowing that one has obtained the correct solution (Runco, 1994; Westcott, 1968). Throughout the discussion a subjective element of experience in creative thought has been mentioned. This is difficult to consider in a quantitative study and it is possible that this played a role in creative thought.

An important variable that might have impacted on the processing of information is which paradigm the students operated from. Unfortunately this was not explored and would have influenced the processing of information as well as the solutions generated (Bohm, 1998; Mindell, 2000).

The psychometric tests may not have operationalised the concept of creative thought correctly and this may have influenced the study. The 19FII in this instance is not based on any theory and the items numerical and scientific interest are misleading as they should be differentiated into physical and natural sciences, and mathematical and accounting disciplines (De Bruin & Du Toit, 1995; Smit, 1991).

4.7.4 Intuition as a Conscious Process

The literature dealt with intuition as inference and this included the emotional arousal and feeling of certainty (Westcott, 1968). Research originating from this premise examines the manner in which data is combined and the level of awareness that the individual has in manipulating sense data as well as the personality characteristics of the individual (Dominowski & Dallob, 1995; Mayer, 1995). The current research only looked at one variable, namely the functions involved in processing data. Thus the variables mentioned above may have influenced the research. Moreover, it appears that factors such as motivation and environmental context play an important part in intuition-as-inference behaviour (Finke et al., 1992).

The cognitive theorists propose that intuition refers to a classification of an event (Stent, 1968). It is suggested that the event is broken down into

categories, experience, and concepts and it is this coding of the event that leads to a development of meaning for the event (Dominowski & Dallob, 1995). In order to determine whether this is indeed the case or to discover how information is coded the subjects need to be interviewed and observed in order to determine how choices were made and solutions arrived at. The present research did not observe the students in coding the information or how they derived meaning from the context and the problem.

Wilson (1998) suggested that intuition is the bridge between cognition and metaphors, or symbols and instinct. This is important for it also ties into intuition as an unconscious process. The literature suggests that metaphors are an important tool for the generation of creative thought (Mumford, 2001). In order to examine whether metaphors assisted the students in their performance interviews, observations would have to be done. The quantitative aspect of this research did not address these variables.

Authors such as Avridson (1997) and Davidson (1995) conceptualise intuition as a process involving coding information and associations made between disparate facts, as well as, a reorganization of information and consciousness. These factors are difficult to measure and observe and rely on self-reporting from subjects, this was not available in the current study. Moreover, Avridson's process extends beyond the perception of information to the encoding of information and an altered state of consciousness. This may exceed the scope of intuition as measured and defined by the JPQ.

Pitcher (1999) and Damasio (2001) indicate that intuition is genetically inherited. This is an interesting point but as no history was taken about the students tested in terms of the JPQ, this variable was not controlled. What is of importance is the proposition that intuition is related to emotional affect, which is related to rational thought (Root-Bernstein, 2002). Thus, the process of arriving at a solution is linked to emotions and then logic. This variable was not studied and may have influenced the students' performance and marks. Moreover, this does not tie into intuition in terms of the way in which it is defined as an irrational function (Spoto, 1995).

4.7.5 Intuition as an Unconscious Process

Intuition in this investigation is conceptualised by Jung (1954). Intuition is an irrational function that is not subject to judgement and perceives information unconsciously (Jung, 1954). Thus, information is derived from the individual's conscious world, unconscious world and collective unconscious (Jung, 1954). This is where the role of symbol and metaphor play an important role. The use of symbols and metaphors in organising and encoding information is important and relies on observation and self-reporting of the subjects. As this is a quantitative study, this material was not available and would provide insight on the process of intuition and possible creative thought. From this perspective intuition is unconscious and cannot be reduced to behaviour or inference (Westcott, 1968).

Although the intuitive function is regarded as an irrational and unconscious function, the test (JPQ) may not have operationalised this concept correctly (Cowan, 1989). Criticism has also been levelled at Jung in defining this concept in that his typology may be flawed or incorrect (Healy, 1989; McCrae & Costa, 1989).

4.7.6 Intuition as a Phenomenological and Metaphysical Process

Burneko (1997) suggests that intuition derives from meaning accorded to personal experiences. Furthermore, he suggests that this meaning is influenced by the metta-pattern, that is the background view of events. Thus, intuition is a subjective experience that connects the individual to the universe and pattern of life (Mindell, 2000). This is linked with Tieszen's (2000) view that creative thought is linked to subjective experiences and the coding of these experiences in categories and noting the relationships between concepts and categories.

In order to explore meaning and how it is constructed views of the dominant philosophy would have to be presented as well as arguments contrary to this discourse. This is beyond the extent of this study but was briefly mentioned in

chapter two. However, a useful point is made in terms of how interpersonal and intrapersonal factors and the external context influence the use of intuition as an acceptable manner in which to generate creative thought or solutions to problems (Burneko, 1997; Mindell, 2000). These factors may indeed stifle the use of intuition and creative thought and further research is needed in this area.

4.7.7 Intuition in Science and Intuition as Aesthetics

The role of intuition in science is similar to that of the processes involved in creative thought. Bunge (1962) conceived of intuition in science as consisting of perception, imagination, reason, and valuation. These are similar to defining the problem, making associations, looking at incongruent information and testing the solution in the evaluation and monitoring stage (Dudek & Cote, 1994; Mumford et al., 1996; Mumford et al., 1997; Mumford, 2001).

Intuition as imagination pertains to using abstract concepts to observe the relationships between objects (Bunge 1962). This is an important consideration when examining the performance of the students in a course that is aimed at developing creative thought within a specific discipline. There is no information on how the students manipulated or dealt with the information in order to produce unique and novel solutions or the parameters within which they worked. Both these variables may have influenced the data.

Root – Bernstein (2002) suggests that intuition is a preverbal process that is linked to affect first and then to logic or rational thought. It is an integration of knowledge and emotion. This is similar to the 'aha' experience that has often been described in the study of creative thought (Runco, 1994). Root-Bernstein (2002) suggests that it is a preverbal process and, thereby, he suggests that it is unconscious and the process cannot be analysed.

4.7.8 Summary

The above discussion has briefly canvassed variables and factors that may have influenced the present study. An emotional and subjective element has been discussed as being connected to arriving at a solution (Root-Bernstein, 2002; Westcott, 1968). Another factor that could have influenced the study was the manner in which the students made associations, processed information, and used abstract thinking in order to manipulate facts (Avridson, 1997; Davidson, 1995). These factors are important and are usually observed from behaviour or direct reporting.

Another factor that was not considered was the genetic predisposition to use intuition in problem solving (Pitcher, 1999; Damasio, 2001). Connected to this factor is the context that the individual finds himself/herself in. A useful point was made about how interpersonal and intrapersonal perception about using intuition as a way of problem solving was made (Burneko, 1997). The construction of meaning is also a factor that plays a role in coding and processing information (Burneko, 1997).

Furthermore, a criticism against Jungian typology has been raised in that it has been suggested that either Jung was incorrect in his conceptualisation of intuition or the test (JPQ) has not operationalised this concept correctly (Cowan, 1989; Healy 1989; McCrae & Costa, 1989).

4.8 CONCLUSION

This chapter explored the results obtained as well as a discussion that encompassed the literature review. The results indicated that there was no relationship between intuition –sensation and creative thought. This is contrary to the literature and as a result a brief discussion of the literature ensued in order to ascertain why the above results were reached. Different variables were mentioned that could ultimately have impacted on the study and which were not controlled.

CHAPTER FIVE

CONCLUSION

5.1 INTRODUCTION

This chapter will encompass the highlights of the preceding chapters as well as an evaluation of the research conducted. A brief discussion will follow touching on the hypothesis, rationale for the research, and a summary of the results obtained. Thereafter, the shortfalls of the study will be discussed along with recommendations for future research in this field.

5.2 HYPOTHESIS

In this study the research examined the correlation between creative thought and intuition. The hypothesis is as follows; whether intuition as defined by the JPQ was linked to creative thought as operationalised by numerical, scientific, and creative thought items in the 19 FII as indicated by the results obtained by engineering students in the course *Introduction to Innovation*.

5.3 RATIONALE OF THE RESEARCH

More than three thousand students visited the Department of Student Support in order to obtain counselling about their current field of study and careers (Yearly report 2002). The students undergo a battery of tests (South African Vocational Interest Inventory, Jung Personality Questionnaire, 19 Field Interest Inventory, Senior Aptitude Test) designed to identify personality, aptitude, and interests.

This study focused on the JPQ and the 19FII in order to ascertain whether there was a relationship between creative thought and intuition. This, it was thought, would assist in the interpretations made in the feedback given to students about fields of study and eventually career choice. The premise underlying this assumption was that if the irrational function of intuition was

connected to creative thought this may reflect the person's ability to process and adapt information and thus impact on their choice in terms of field of study.

5.4 SUMMARY OF RESULTS

The results discussed in chapter four indicated that there was no relationship between creative thought and intuition. The correlation between intuition and creative thought is a negative correlation of $-0,20$ between creative thought and intuition –sensation. This indicates that there is a slight tendency that an increase in intuition would correlate with a higher interest in careers involving creative thought because of the negative correlation.

There is a positive correlation between the items numerical (0,06) and creative thought (0,08), whilst science is negatively correlated (-0.16) with the N-S index and numerical having a positive correlation with the N-S index. The results seem to infer that the more inclined a person is to process information using sensation, that there may be a tendency indicating an interest in numbers and possibly a career involving this interest.

However the probability statistic fell below 0.05 and 0.03 and as such the results obtained are not significant and no statistical inference can be drawn.

In terms of determining whether the use of the irrational function of intuition-sensation impacted on marks obtained in the course *Introduction to Innovation*, an analysis of percentages was reported in table 4.6. This indicated that the marks were spread out fairly equally indicating no real difference between those whose dominant irrational function is intuition and those whose dominant function is sensation and those who use both. This indicates that there is no relationship between creative thought and intuition

5.5 PROBLEMS WITH THE DATA

Caution was raised in terms of the fact that the chi-squared test might not have accurately reflected the data as the cell for N/S (intuition and sensation) contained less than 10 in number. This deficiency was addressed by the use of the Spearman's Correlation Coefficient test, which is more sensitive in terms of searching for relationships between the variables (McCall, 1986).

A further caution was raised in terms of the range effect that may be reflected in the high means in the score interest in numerical and creative thought this is reflected in table 4.5. That is, the ceiling of scores that the subjects could have obtained for the items in the 19FII is a maximum of nine. It is possible that there were subjects who would have scored higher than this if the test allowed for scores higher than nine and the scores would then have been spread more evenly instead of clustering on the high end of the scale (Neuman, 2000).

The sample group consisted of 30 subjects. This is a small group and, as such, it is difficult to generalise. This small sample group may have influenced the results. Moreover the variables were examined simultaneously and may have impacted on each other thus influencing the data (Neuman, 2000).

The results obtained are contrary to the literature discussed in chapter two. Differing factors and variables were not controlled and these may have impacted on the results.

5.6 EVALUATION OF THE RESEARCH

This section will assess the current study on creative thought and intuition. The discussion is two-fold in that the shortfalls of the research will be discussed and thereafter recommendations will be made in terms of further research in this area.

5.6.1 Shortfalls of the Study

This section will briefly discuss the variables that were not controlled in the study and how they may have influenced the results obtained.

As previously mentioned, diverse factors and variables possibly influenced the study. Of the variables that were not controlled for, one was the level of motivation to perform in the course *Introduction to Innovation*. Kay (1994) suggests that this is an important factor in creative thought. Moreover, the subjects that approached the Department of Student Support all sought career counselling, indicating that there was an element of doubt about their current field of study and eventual career choice. These two factors may have influenced each other and impacted on the data.

The literature indicates that from a cognitive perspective creative thought is composed of various processes or stages; defining the problem, categorising information, processing information and giving meaning to the information (Dunbar, 1995; Mumford et al., 1997; Patrick, 1937; Sternberg & Lubart, 1991). Intuition as a cognitive process involves coding, combining, and manipulating sense data derived from the environment and personality also plays an important role in intuition (Avridson, 1997; Davidson, 1995; Dominowski & Dallob, 1995; Finke et al., 1992; Mayer, 1995; Stent, 1968). These factors were unknown and might have impacted on the data.

There was also no information about the level of expertise that the subjects had which, in terms of the literature, influences the development of novel ideas which is in turn linked to the use of intuition in an unconscious trial and error behaviour that forms and generates analogies metaphors and novel combinations (Chi, et al., 1982; Pfenninger & Shubik, 2001; Quin & Simon, 1990). Nor was there any information about the paradigm used to approach facts and the problems posed in their course (Bohm, 1998; Mindell, 2000). Another important variable that impacts on generating novel ideas is social evaluation (Gilhooly, 1982; Mumford, 2001; Runco & Chand, 1994; Wilson et al., 1954). Other factors, such as the amount of solutions generated and the

originality of solutions generated were not obtained (Guilford, 1950). These conscious factors were not observed or recorded and I submit would have strongly influenced creative thought in the subjects.

Another part of the creative thought process involves experience and how meaning is allocated to various experiences (Burneko, 1997; Root-Bernstein, 2002). It is also suggested that intuition is linked to emotion first and then to logic or rational thought. This variable was not observed and is a subjective factor that needs to be recorded through interviews in order to obtain an understanding of the choices made in the creative thought process. Various authors suggest that creative thought and intuition are linked to altered states of consciousness (Avridson, 1997; Gerlernter, 1994; Mindell, 2000). This is once more linked to the subjective element in the process and relies on a more qualitative approach to investigate this way of being in order to produce a novel solution.

Part of the process of creative thought is unconscious and cannot be observed (Kris, 1952; Jung, 1923) Anecdotal evidence suggests that the unconscious plays a role in generating solutions (Gilhooly, 1982; Miller, 1997). The unconscious is a variable that cannot be controlled and can only be observed indirectly. It is for these reasons that the unconscious may have influenced the data.

It was mentioned earlier that the Collective Unconscious influences the creative thought process in terms of symbols and myths (Jung, 1969). Wilson (1998) suggests that intuition acts as a bridge between the ability to express thought through symbol or metaphor. This is a difficult variable to control because part is unknown and part depends on the individual's skill in communicating an idea, which is a subjective element. This factor might also have influenced the content of the solutions generated in the creative thought process and may thus have impacted on the performance of the subjects in the course *Introduction to Innovation*.

Other factors, such as a genetic predisposition to use intuition were not investigated and may have influenced the study (Damasio, 1994; Pitcher, 1999). That is, there was no information about the sample groups' propensity to use or rely on intuition to provide solutions or whether this was a characteristic in their family.

5.6.2 Shortcomings with the Psychometric Tests

This section will briefly discuss the possible problems in the use of the tests the 19FII and the JPQ to examine the link between intuition and creative thought.

The reason that there is no correlation between creative thought and intuition may be due to the fact that the item creative thought is derived from a test that is not based on any particular theory (De Bruin & Du Toit, 1995). As such, the notion of creative thought as contained in the 19FII may be at odds with the concept of intuition in the JPQ, that is, the idea of intuition as conceptualised by Jung (1954).

Smit (1991) suggests that the fields numerical and scientific interest may be misleading in that they should be divided into biological and physical sciences, and maths and accountancy. These two fields were included in the research in order to extend the span of creative thought to these fields. This may have been too inclusive and interfered with the factor creative thought.

Numerous variables were investigated simultaneously, intuition-sensation, creative thought, scientific, and numerical interest and, as such, they may have exerted influence on each other thus obscuring the possible relationship between the two main variables of intuition-sensation and creative thought.

Although the intuitive function is regarded as an irrational and unconscious function, the test (JPQ) may not have operationalised this concept correctly (Cowan, 1989). Criticism has also been levelled at Jung in defining this

concept in that his typology may be flawed or incorrect (Healy, 1989; McCrae & Costa, 1989).

Another factor that might have influenced the results was the small group that was eventually selected. This group consisted of thirty subjects and this number is considered too small to make a generalisation to the greater population (Neuman, 2000)

5.6.3 Recommendations

This section will briefly outline suggestions for further studies exploring the link between intuition and creative thought.

In order to determine whether there is a link between intuition and creative thought the concepts need to be carefully defined. This is important as it takes cognisance of the philosophical standpoints that then determine how data is interpreted.

To obtain clarity research should be conducted first from a cognitive perspective in order to obtain information about the processes that form part of creative thought and importantly how information is adapted and manipulated. This could be broken down into many stages in that research could be conducted separately for each process problem definition, information processing, incubation, generating the solution, and evaluation of the solution (Patrick, 1937; Runco & Chand, 1994).

The strategies that assist in creative thought could also be examined and these include, fluency, flexibility, and originality (Wilson et al., 1954). This would assist in determining what strategies assist in finding a solution.

Part of creative thought has an emotional or subjective element and this needs to be either observed or a qualitative approach should be used to explore how meaning is derived from events and how experiences contribute to the process (Burneko, 1997; Root-Bernstein, 2002). It is in constructing

meaning derived from experience, which is subjective and emotional rather than rational, that an interface occurs between the conscious and unconscious (Tieszen, 2000). Consequently it is at this stage that the unconscious enters into the creative thought process. This particular process needs further exploration.

The literature suggests that there is a link between intuition and creative thought (Jung, 1954; Mindell, 2000). Intuition is a difficult variable to define and to measure. Further research could be done with the aid of different tests such as the Myers Briggs Type Indicator (MBTI) or the revised NEO Personality Inventory (NEO PI- R) that examine various aspects of intuition (Furnham et al., 2003; Moody, 1988). This would then create a system of checks and balances, which would establish that the variable being measured is intuition as discussed by Jung (Jung, 1954).

5.7 CONCLUSION

The aim of this study was to determine the link between intuition and creative thought. This research was also aimed at assisting students and counsellors in providing feedback to students based on the 19 FII and the JPQ in terms of field of study and eventual career choice. The results obtained in terms of indicating whether there was a link between intuition and creative thought showed that there was a tenuous link between intuition and creative thought but this was statistically insufficient to infer a relationship. The results for the target group of subjects who were enrolled for the course *Introduction to Innovation* were also inconclusive. Consequently, no inference can be drawn about whether the JPQ or the 19 FII have a predictive value in terms of performance in the course *Introduction to Innovation*. Therefore no recommendations can be made relating to how feedback can be given by counsellors to students based on the JPQ and the 19FII in terms of field of study and career choice.

This chapter has touched on the results obtained in this study as well as the difficulties encountered in this research. Numerous variables were mentioned

that could have impacted on the current study. These variables may have contributed to the inconclusive results obtained thereby limiting the contribution to the scientific debate on this subject. Recommendations were made in terms of the above-mentioned variables and that, in order to obtain definitive and clear results, these need to be controlled in future research.

REFERENCES:

Avridson, P. S. (1997). Looking intuit: A phenomenological exploration of intuition and attention. In R. Davis –Floyd, & P. S. Avridson (Eds.), **Intuition the inside story interdisciplinary perspectives**. (pp. 40-55). New York: Routledge.

Bastick , T. (1982). **Intuition: How we think and act**. Chichester: John Wiley & Sons.

Bateson, G. (1979). **Mind and nature: A necessary unity**. New York: E. P. Dutton.

Baughman, W. A., & Mumford, M. D. (1995). Process analytic models of creative capacities :Operations influencing the combination and reorganisation process. **Creativity Research Journal**, **8**, 37-62.

Beder, S. (1998). **The new engineer: Management and professional responsibility in a changing world**. Australia: Macmillan Publications.

Bejar, I. I., Chaffin, R., & Embertson, S. (1991). **Cognitive and psychometric analysis of analogical problem solving**. New York: Springer-Verlag.

Berne, E. (1955). Intuition IV: Primal images and primal judgements. **Psychiatric Quarterly** **29**, 634-668.

Berne, E. (1962). Intuition VI: The psychodynamics of intuition. **Psychiatric Quarterly**, **36**, 294-300.

Birgerstam, P. (2002). Intuition the way to meaningful knowledge. **Studies in Higher Education** ,**27**,(4), 431-444.

Blanshard, B. (1964). **The nature of thought**. Atlantic Highlands: New Jersey Humanities Press Vol 2.

Boden, M. A. (1998). **Dimensions of creativity**. Massachusetts: Bradford, MIT.

Bohm, D. (1998) **On creativity**.. (Ed.) L. Nichol. London: Routledge.

Bonabeau, E. (2003). Don't trust your gut. **Harvard Business Review**, **81**, (5), 98-107.

Bunge, M. (1962). **Intuition and science**. Connecticut, USA: Greenwood Press Publishers.

Burneko, G. (1997). Wheels within wheels, building the Earth intuition, integral consciousness, and the pattern that connects. In R. Davis- Floyd & P.

S. Arvidson (Eds.), **Intuition the inside story interdisciplinary perspectives.** (pp.81-100). New York: Routledge.

Bruner, J.S., & Clinchy, B. (1966). Towards a disciplined intuition. In J. Bruner (Ed), **Learning about learning.** no. 15 Bureau of Research (Co-operative Research Monograph).

Cannon, W. B. (1945). **The role of hunches the way of the investigator.** New York: WW Norton & Co Inc.

Chandrasekhar, S. (1987). **Truth and beauty. Aesthetics and motivations in science.** Chicago: University of Chicago Press.

Chi, M. T., Glaser, R., & Rees, E. (1982). Expertise in problem solving. In R. J. Sternberg (Ed.), **Advances in the psychology of human intelligence.** (pp.94-149). Hillsdale, N J: Lawrence Erlbaum Associates Inc.

Chi, M. T., Glaser, R., & Farr, M. (1987). **Nature of expertise.** Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Chi, M. T., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self explanations: How students study and use examples in learning to solve problems. **Cognitive Science** ,13, 145-182.

Clarke, R. D. (2001). Intuition. **Black Enterprise**,31,(9), 145-147.

Coetzee, M., & Schreuder, A. M. G. (2002). The relationship between career patterns and personality types. **Journal of Industrial Psychology**,**28**, (1),53-59.

Cowan, D. A. (1989). An alternative to the dichotomous interpretation of Jung's Psychological Functions: Developing more sensitive measurement technology. **Journal of Personality Assessment**, **53**, (3), 459-471.

Csikzentmihalyi, M. (1988). Systems view of creativity. In R. J. Sternberg (Ed.), **The nature of creativity**. (pp325-339).New York :Cambridge University Press.

Csikzentmihalyi, M. (1996). **Creativity**. New York: Harper Collins.

Damasio, A.R. (1994). **Descartes' error: emotion reason and the human brain**. New York: Gosset/Putman.

Damasio, A.R. (2001). Some notes on brain, imagination and creativity. In K. H. Pfenninger, & V. R. Shubik (Eds.), **The origins of creativity**. (pp.59-68). Oxford: Oxford University Press.

Davidson, J. E., & Sternberg, R. J. (1984). The role of insight in intellectual giftedness. **Gifted Child Quarterly**,**28**,58-64.

Davidson, J .E. (1995). The suddenness of insight. In R. J. Sternberg, & J.E. Davidson (Eds.), **The nature of insight**. (pp.125-154). Cambridge, MA: MIT Press.

De Bruin, G. P., & Du Toit, K. (1995). Die faktorstruktuur van die 19 Veld-Belangstellings Vraelys en Holland se struktuur van belangstellings. **Journal of Industrial Psychology**, **21**, (3), 24-28.

De Bruin, G. P. (2002). The relationship between personality traits and vocational interests. **South African Journal of Industrial Psychology**, **28**,149-52.

Dominowski, R. L., & Dallob, P. (1995). Insight and problem solving. In R. J. Sternberg, & J.E. Davidson (Eds.), **The nature of insight**. (pp.33-64). Cambridge, M.A.: MIT Press.

Dudek, S., & Cote, R. (1994). Problem Finding Revisted. In M. A. Runco (Ed.), **Problem finding, problem solving and creativity**. (pp. 130-153). Norwood, New Jersey: Ablex Publishing Corporation.

Dunbar, K. (1995). How Scientists really reason: Scientific reasoning in real world laboratories. In R. J. Sternberg, & J. E. Davidson (Eds.), **The nature of insight**. (pp.365-395). Cambridge, MA: MIT Press.

Du Toit, L.B.H. (1987). **Handleiding vir die Jung-persoonlikheidsvraelys (JPV)**. Pretoria: Raad vir Geesteswetenskaplike Navorsing.

Du Toit, L. B. H. (1995). **Jung Personality Questionnaire**. Pretoria HSRC.

Einstein, A., & Infeld, L. (1933). **The evolution of physics**. New York: Simon & Schuster.

Eysenck, H. J. (1993). Creativity and Personality : An attempt to bridge divergent traditions. **Psychological Inquiry**,4, (3), 238-246.

Finke, R. A., Ward, T. B., & Smith, S. M. (1992). **Creative cognition: Theory ,research and applications**. Cambridge, MA: MIT Press.

Fleishman, E. A., & Mumford, M. D. (1988). The ability requirements scales. In S. Gael (Ed.), **The job analysis handbook for business , industry and government**. (pp.917- 935). New York: Wiley.

Foltz-Gray, D. (2003). How to tap your intuition. **Health** ,17,(2),167-179.

Fouche, F. A., & Alberts, N.F. (1971). **Manual for the 19 field interest inventory (19FII)**. Pretoria :Human Sciences Research Council.

Freud, S. (1908). Creative Writers and Day Dreaming. In J. Strachey (Ed.), **The standard edition of the complete psychological works of Sigmund Freud Vol 9**. (pp. 143-146,153). London: Hogarth Press.

Furnham, A., Moutafi, J., & Crump, J. (2003). The relationship between the revised NEO-personality inventory and the Myers Briggs Type indicator. **Social Behavior and Personality**,31,(6),577-584.

Gick, M. L., & Lockhart, R. S. (1995). Cognitive and affective components of insight. In R. J. Sternberg, & J. E. Davidson (Eds.), **The nature of insight**. (pp.196-227). Cambridge, MA: MIT Press.

Gelernter, D. (1994). **The muse in the machine: Computers and creative thought**. London: Fourth Estate Ltd.

Getzels, J. W., & Csikzentmihalyi, M. (1976). **The creative vision: A longitudinal study of problem finding in art**. New York: Wiley.

Gilhooly, K. J. (1982). **Thinking directed, undirected and creative**. London: Academic Press Inc. Ltd.

Guilford, J. P. (1950). Creativity. **American Psychologist**, 5, 444-454.

Guilford, J. P. (1983). Transformation:Abilities or functions. **Journal of Creative Behaviour**, 17 , 75-86.

Hall, K.H. (2002). Reviewing intuitive decision making and uncertainty: the implications for medical education. **Medical Education**,**36**,(3), 216-225.

Hartung, P. J. (2002). Reason ,intuition and social justice: elaborating on Parson's career decision making model. **Journal of Counseling and Development** ,**80**, 41-54.

Hayes, J. R. (1978). **Cognitive Psychology: thinking and creating**. Homewood, Illinois: The Dorsey Press.

Healy, C.C. (1989). Negative: The MBTI: Not ready for routine use in counselling. **Journal of Counselling and Development**, **67**, 487-488.

Heisenberg, W. (1958). **Physics and philosophy**. New York: Harper & Row.

Hogan, R., & Blake, R. (1999). John Holland's vocational typology and personality theory. **Journal of Vocational Behaviour**, **55** ,41-56.

Holman,L. E. (1995). **The validation of the field –environment –duty occupational classification system and interest test**. (Dphil.) University of South Africa, Pretoria.

Houtz, J. C. (1994). Creative problem solving in the classroom: Contributions of four psychological approaches. In M. A. Runco (Ed.), **Problem finding, problem solving and creativity**. (pp.153- 165). Norwood, New Jersey: Ablex Publishing Corporation.

Howell, D. C. (1992). **Statistical methods for psychology**. (Third ed.): Belmont, California: Duxbury Press.

Huysamen, G. K. (1993). **Metodologie vir die sosiale en gedragwetenskappe**. Pretoria: Sigma Press.

Isaak, M. I., & Just, M. A. (1995). Constraints on thinking in insight and invention. In R. J. Sternberg, & J. E. Davidson (Eds.), **The nature of insight**. (pp.281-325). Cambridge, MA: MIT Press.

Jensen , A. (1981). **Bias in mental test scores**. New York: Free Press.

Johnson, E. A. (1971). The Nature and Significance of Creativity. In A. K . Kanth, K .S. Rao, A. K. P. Sinha, & Misra, H K (Eds.), **Contributions to psychology**. (pp.59-71). Delhi: Rakesh Fine Art Printers.

Jung, C. G. (1923a). **Psychological types**. London Routledge & Kegan Paul Ltd.

Jung, C. G. (1923b). On the relation of analytical psychology to poetic art
British Journal of Medical Psychology ,3, 219-231.

Jung, C.G. (1950). **The integration of the personality**. London: Routledge
& Kegan Paul Ltd.

Jung, C. G. (1954). **The development of personality**. London: Routledge &
Kegan Paul Ltd.

Jung, C. G. (1969). **The Archetypes and the Collective Unconscious**.
Princeton: Princeton University Press (Trans. R.F.C. Hull Bollingen Series
XX).

Kapes, J. T., & Mastie, M. M. (Eds.). (1988). **A counsellor's guide to career
assessment instruments**. (2nd ed.) Alexandria,VA: National Careers
Development Association.

Kay, S. (1994). A method for investigating the creative thought process. In
M.A. Runco (Ed.), **Problem finding, problem solving and creativity**.
(pp.116-127). Norwood, New Jersey: Ablex Publishing Corporation.

Kettner, N. W., Guilford, J. P., & Christensen, P. R. (1959). A factor analysis
study across the domains of reasoning, creativity and evaluation.
Psychological Monographs, 9, 1-31.

Koestler, A. (1964). Bisociation in creation. In A. Rothenberg, & E. Hausman (Eds.), **The creativity question**. (pp.45-55). Duke University Press.

Kohler, W. (1929). **Gestalt psychology**. New York: Liveright.

Koontz, K. (2001). Intuition gets real. **Health**, **15**,(9), 98-102.

Kris, E. (1952). **On preconscious mental processes psychoanalytic explorations in art**. New York: International Universities Press Inc.

Kuhn, T. S. (1970). **The structure of scientific revolutions**. Chicago: University of Chicago Press.

Li, R. (1996). **A theory of conceptual intelligence: thinking, learning, creativity and giftedness**. Westport: Praeger Publishers.

Lindley, L. D., & Borgen, F. H. (2000). Personal style scales of the Strong Interest Inventory: Linking personality and interests. **Journal of Vocational Behaviour** **57**, 22-41.

Linzey, M. (2001). On the secondness of architectural intuition. **Journal of Architectural Education**, 43-50.

Mayer, R. E. (1992). **Thinking, problem solving, cognition**. (2nd ed.). New York: Freeman.

Mayer, R. E. (1995). The search for insight: grappling with Gestalt psychology's unanswered questions. In R. J. Sternberg, & J. E. Davidson (Eds.), **The nature of insight**. (pp.3-33). Cambridge ,MA: MIT Press.

Maddi,S. R. (1996). **Personality Theories: a comparative analysis**. (6th ed). Pacific Grove: A Brooks Cole Publishing Co.

McCall, R. B. (1986). **Fundamental statistics for behavioural sciences** (4th ed.). San Diego: Harcourt Brace Jovanovich, Publishers.

McCrae, R.R., & Costa, P. T. (1989). Reinterpreting the Myers Briggs Type Indicator from the perspective of the Five Factor Model of Personality. **Journal of Personality** ,57,(1), 17-40.

Mc Mullen, B. (2003). Spiritual Intelligence. **Student BMJ**,11, 60-64.

Miller, A. I. (1997). Cultures of creativity mathematics and physics **Diogenes**,177 ,(45), 53-71.

Mindell, A. (1989). **The year 1 : Global Process Work..** New York: Viking Penguin Arkana Inc.

Mindell, A. (2000). **Quantum mind: The edge between physics and psychology**. Portland, OR: Lao Tse Press.

Monte, C. F. (1980). **An introduction to theories of personality.** (2nd Ed.).
New York: Holt Rinehart and Winston.

Montgomery, D., Bull, K. S., & Baloché, L. (1993). Characteristics of the
creative person. **American Behavioural Scientist**,**37**, (1), 68-78.

Moody, R (1988). Personality preferences and foreign language learning.
Modern Language Journal,**72**,(4), 389-401.

Mumford, M. D., & Gustafson, S. B. (1988). Creativity syndrome: Integration
,application, and innovation. **Psychological Bulletin**, **103**, 27-43.

Mumford, M. D., Baughman, W.A., & Wayne, A. (1993). Developing creative
capacities in gifted and talented children. **Roeper Review**, **16**, (1), 16-22.

Mumford, M. D., Baughman, W. A., Supinski, E. P., & Maher, M. A. (1996).
Process- based measures of creative problem – solving skills: II. Information
encoding. **Creativity Research Journal**, **9**,(1), 77-88.

Mumford, M. D., Baughman, W. A., Supinski, E. P., Maher, M. A., &
Costanza, D. P. (1997). Process based measures of creative problem
solving skills:IV. Category combination. **Creativity Research Journal**, **10**,(1),
59-71.

Mumford, M.D., Baughman, W. A., Supinski, E. P., Costanza, D. P., & Threlfall, V. (1997). Process based measures of creative problem solving skills: V. Overall prediction. **Creatvity Research Journal**, **10**, (1), 73-85.

Mumford, M.D. (1998). Creative thought: structure, components, and educational implications. **Roeper Review**, **21**,14-20.

Mumford, M. D. (2001). Something old, something new: Revisiting Guilford's conception of creative problem solving. **Creativity Research Journal** ,**13**, (3), 4, 267-276.

Myers, I. (1962). **The Myers-Briggs Type Indicator**. Palo Alto, CA: Consulting Psychologists Press.

Myers, I., & McCauley, M.H. (1985). **Manual : a guide to the development and use of the Myers Briggs Type Indicator**..Palo Alto, CA: Consulting Psychologists Press.

Nicol, J. (1978). **Die differesiele warde van die 19 Veld – Belangstellinfsvraelys**.. Published MA thesis. University of Pretoria.

Neuman, W.L. (2000). **Social research methods: qualitative and quantitative approaches**. Boston: Allyn and Bacon.

Patrick, C. (1937). Creative thought in artists. **Journal of Psychology** ,4, 35-40,51-54,66-67.

Paul, R. W. (1993). The logic of creative and critical thinking. **American Behavioural Scientist**,37,(1),21-39.

Peck, R., Olsen, C., & Devore, J. (2001). **Introduction to statistics and data analysis**. Pacific Grove, CA: Duxbury Press.

Perkins, D. N. (1992). The topography of invention. In R. J. Weber, & D. N. Perkins (Eds.), **Inventive minds: Creativity in technology**. (pp.238-250). New York :Oxford University Press.

Perkins, D. N. (1995). Insight in minds and genes. In R. J. Sternberg, & J. E. Davidson (Eds.), **The nature of insight**. (pp.495-533). Cambridge, MA: MIT Press.

Pfenninger, K . H., & Shubik, V. R. (Eds.). (2001). **The origins of creativity**. Oxford, UK: Oxford University Press.

Pitcher, P. (1999). Artists, craftsmen & technocrats. **Training and Development**, 53, (7), 30-35.

Plato (1961). Phaedrus Reginald Hackforth, trans in Edith Hamilton and Huntington Cairns (eds), **Plato The Collected Dialogues**. (pp.475-525). New York: Bollingen Foundation.

Quin ,Y., & Simon, H. A. (1990). Laboratory replication of scientific discovery process. **Cognitive Science 14**, 281-312.

Ramaprasad, A., & Mitroff, I. (1984). On formulating strategic problems. **Academy of Management Review,9**, 597-605.

Redmond, M. R., Mumford, M. D., & Teach, R. J. (1993). Putting creativity to work: Leader influences on subordinate creativity. **Organizational Behavior and Human Decision Processes, 55**, 120-151.

Robinson, W. (2001). Listening to your inner voice: The art of intuition. **Mothering, 105**, 72-78.

Root-Bernstein, R. S. (2002). Aesthetic cognition **International Studies in the Philosophy of Science, 16**, (1), 61-78.

Rothenberg, A., & Hausman, E. (Eds.),. (1976). **The Creativity Question** Duke University Press.

Rothenberg, A. (1978). The unconscious and creativity. In A. Roland (ed.), **Psychoanalysis creativity and Literature A French American inquiry.** (pp.40-56). New York: Columbia University Press.

Runco, M. A. (Ed.), (1994). **Problem finding, problem solving, and creativity.** Norwood, New Jersey: Ablex Publishing Corporation.

Runco, M. A., & Chand, I. (1994). Problem finding, evaluative thinking and creativity. In M. A. Runco (Ed.), **Problem finding, problem solving, and creativity.** (pp.40-71). Norwood ,New Jersey: Ablex Publishing Corporation.

Ruth-Sahd, L. (2003). Intuition. **Nursing Education Perspectives,24,** (3),129-134.

Sharf, R. S. (1997). **Applying career development theory to counseling.** (2nd Ed.) Pacific Grove, CA: Brooks /Cole Publishing Company.

Sheldrake, R. A. (1995). **A new science of life: The hypothesis of morphic resonance.** London: Inner Traditions Intl.

Simonton, D. K. (1998). Donald Campbells model of the creative process: Creativity as blind variation and selective retention. **Journal of Creative Behaviour, 32,** 153-158.

Simonton, D. K. (1990). **Psychology, science and history**. New Haven, CT: Yale University Press.

Smit, G. J. (1991). **Psigometrika aspekte van toetsgebruik**. Pretoria: Haum Tersier.

Spoto, A. (1995). **Jung's Typology in Perspective**. Wilmette, Illinois: Chiron Publications.

Stent, G. S. (1968). What they are saying about honest Jim. **Quarterly Review of Biology**, **43**, 179-184.

Sternberg, R. J., & Lubart, T. I. (1991). An investment theory of creativity and its development. **Human Development**, **34**, 1-31.

Storr, A. (1973). **Jung**. Great Britain: Fontanna.

St Clair, M. (1980) **Object Relations and self psychology**. Moneterrey: Brooks Cole.

Sundberg, N. D. (1977). **Assessment of persons**. Englewood Cliffs, NJ: Prentice Hall.

Tieszen, R. (2000). Intuitioninism meaning theory and cognition. **History & Philosophy of Logic**, **21**, (3), 179-194.

Thompson, T. (2002, Aug). Intuition. **Good Housekeeping** , 235, (2), 68-73.

Thorndike, E. L. (1898). Animal Intelligence :An experimental study of the associative processes in animals. **Psychological Monographs** 2, 8

University of Pretoria, Regulations and Syllabi. Faculty of Engineering ,built environment and information technology. (2003, January).p95.

University of Pretoria Student Support Departmental Yearly Report. (2000, January). p.5.

University of Pretoria Student Support Departmental Yearly Report. (2001, January). p7.

University of Pretoria Student Support Departmental Yearly Report (2002, January). p3.

Van Gundy, A. (1987). **Creative Problem Solving**. Connecticut USA: Greenwood Press Inc.

Van Staden, F.J. (1992). **n Validering van die Jung-Persoonlikheidsvraelys**. Ongepubliseerd MA-skripsie, Rand Afrikaans University.

Viljoen, S. (1992). **The validity of the Jung Personality Questionnaire with reference to tradesmen**. Published MA-dissertation ,Rand Afrikaans University.

Von Franz, M.L. (1992). **Psyche and matter**. Boston Mass. Shambhala Publications.

Wallas, G. (1926). Stages of control: The art of thought. In A Rothenberg, & E Hausman (Eds.), **The creativity question**. (pp.130-135). Duke University Press.

Wanless, J. (2002). Using intuition at work. **Women in Business** , 54 ,(3), 44-49.

Weinrach, S. G., & Srebalus, D.J. (1990). Holland's theory of careers. In D. Brown, & L. Brooks (Eds.), **Career choice and development**. (pp.105-107). San Francisco: Jossey –Bass.

Werbelloff, M. (1996). **Statistics a friendly introduction**. Pinegowrie, S. A.: Japie Stander Education.

Wertheimer, M. (1945). Productive Thinking. New York: Harper & Row.

Westcott, M. R. (1968). **Toward a contemporary psychology of intuition: A historical, theoretical, and empirical inquiry.** New York : Holt, Rinehart and Winston , Inc.

Williams, D.I., & Irving, J. A. (1996) Intuition ;phenomenology; counselling. **Counselling Psychology Quarterly**,**9**,(3),221-229.

Wilson, J M. (1998). Art-making Behaviour : Why and how arts education is central. **Arts Education Policy Review**,**99**,(6),26-33.

Wilson, R. C., Guilford, J. P., Christensen, P R., & Lewis D J (1954). A factor analytic study of creative thinking abilities . **Psychometrica** ,**19**, 297-311.